TELEDYNE LECROY
Everywhereyoulook™

Sierra M6-2
SAS/SATA Protocol Analyzer

User Manual

For Software Version 5.30
Document Version 5.30

September 2013

Teledyne LeCroy Protocol Solutions Group

Trademarks and Servicemarks:

Teledyne LeCroy, Teledyne LeCroy Protocol Solutions Group, CATC, SASSuite, SATASuite, SASTracer, SATracer, SASTrainer, SATrainer, SASTracker and Avalanche are trademarks of Teledyne LeCroy. Microsoft, Windows, Windows 2000,Windows XP, Windows Vista and Windows 7 are registered trademarks of Microsoft Inc.

Intel and Pentium are registered trademarks of Intel Corporation.

All other trademarks and registered trademarks are property of their respective owners.

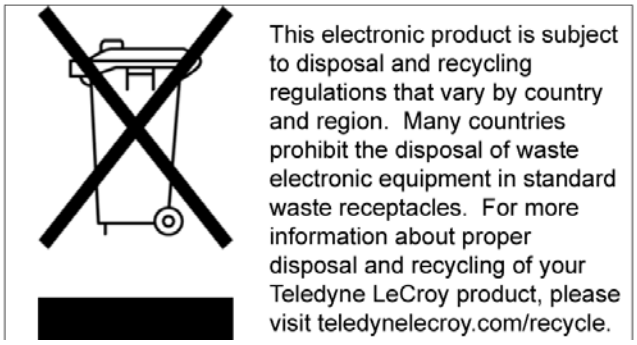
THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL INFORMATION, EXAMPLES AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE REPRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS ARE FULLY RESPONSIBLE FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN INFORMATION THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT TELEDYNE LECROY FOR A COPY.

© 2012 Teledyne LeCroy, Inc. All rights reserved.

This document may be printed and reproduced without additional permission, but all copies should contain this copyright notice.

WEEE Program


This electronic product is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

Teledyne LeCroy
3385 Scott Blvd.
Santa Clara, CA 95054
TEL: 800-909-7112 (USA and Canada)
TEL: 408-653-1260 (worldwide)

Contents

Chapter 1: Introduction 17
1.1 Analyzer Overview 17
1.2 Features 18
1.3 Receiving Your Analyzer 18
1.4 Unpacking the Analyzer 19
1.5 Analyzer Features 19
1.6 LEDs 19
1.6.1 Status and Configuration Display 20
1.7 Installing Your Analyzer 20
1.7.1 Software Installation 20
System restart 20
Error Message 20
1.8 Hardware Setup 21
1.8.1 Separate Systems 21
1.8.2 Connecting in General 21
1.8.3 Cables to Use 22
1.9 Expandability 23
1.9.1 Cascading with STX SYNC Expansion Cards 23
Cascading 23
1.9.2 Select Device 25
1.9.3 Cascading with CATC SYNC Expansion Card 30
1.9.4 Using the Power Expansion Card 30
Power Expansion Card (part number: ACC-EXP-004-X) 30
Power Expansion Card 2 (part number: ACC-EXP-005-X) 31
1.9.5 Removing Expansion Cards 32
1.10 Connecting via Ethernet 34
1.11 Connecting to a Network 34
1.12 Connecting over Different Subnets 35
1.13 TCP and UDP Ports Must Be Open to Connect over Ethernet 35
1.14 Launching Your Analyzer 35
1.15 Operating in Simulation Mode 35

1.16 Using the Software 35
1.17 Getting Started with the Protocol Analyzer 36
1.18 Protocol Analyzer Initiator Emulator or Host Emulator 36
1.19 Performance Analyzer 37
1.20 Target Emulator or Device Emulator 37
1.21 Teledyne LeCroy SAS and SATA Protocol Suite Menu Options and Toolbars 37
1.21.1 File 38
1.21.2 Setup 38
1.21.3 Session 39
1.21.4 Analysis 39
1.21.5 Viewing Captured Data 41
1.21.6 Navigation 41
1.21.7 View 42
1.21.8 Window 43
1.21.9 Help 43
1.21.10 Toolbars 43
1.22 Port Status 44
1.23 InFusion 44
1.24 Trainer 44

Chapter 2: Protocol Analysis 47
2.1 Easy Mode (Pre-Defined Setups) 47
2.2 Main Window 47
2.3 Project Tree 49
2.3.1 Capture Tab Fields 49
Exclude XXXX 49
2.4 SAS/SATA Software Menus and Toolbars 50
2.4.1 SAS Main Toolbar 50
2.4.2 SATA Main Toolbar 51
2.5 Start Recording 51
2.5.1 Launch Jammer 53
2.5.2 Launch Trainer 53
2.5.3 CrossSync Control Panel 53
Launching the CrossSync Control Panel 53
2.5.4 Save Workspace 54
2.5.5 Saving a Trace Capture 54
2.5.6 Exporting 55
Export to Text/Excel 56
Export to Initiator Emulator (SAS) or Host Emulator (SATA) 57
Export to Trainer 58
Export Read/Write Command Report 59
2.5.7 Export Paired SAS Address Report 59
2.5.8 Trace Properties 60

2.5.9 Edit Comment 60
2.6 Projects 60
New Default Project 60
Last Project 60
2.6.1 Project File Types 60
2.6.2 Example Projects 61
2.6.3 Run an Example Analysis Project 61
2.6.4 Patterns and Data Capture Setup 63
2.6.5 Choose a Parameter 64
2.6.6 Exclude Patterns 64
2.6.7 Pre and Post Trigger Data Capture 65
2.6.8 Defining Patterns 66
Primitive 67
Data Pattern 67
2.6.9 Protocol Errors 68
Protocol Error Descriptions 68
2.6.10 STP Frame 69
Available FIS Types 70
2.6.11 Address Frame (SAS only) 70
2.6.12 SMP Frame (SAS only) 71
2.6.13 SSP Frame (SAS only) 72
2.6.14 FIS Type (Frame Information Structure) (SATA only) 72
Available FIS Types 73
2.6.15 STP Frame Pattern 73
Register Host to Device 74
Register Device to Host 74
Set Device Bits 75
DMA Activate 75
DMA Setup 76
BIST 76
PIO Setup 77
Data 77
Vendor 78
2.6.16 Trigger Setup 78
Snapshot Mode 79
Manual Trigger Mode 79
Any Trigger in Pattern Mode 79
Choosing a Parameter 81
Triggering on a Timer 82
Timeout 82
External/Manual Trigger 83
Bus Condition 84
Symbol 84

Primitive 85
ATA Command 87
ATAPI 88
Data Pattern 89
Protocol Errors 90
STP Frame 91
Address Frame (SAS only) 92
SMP Frame (SAS only) 93
SSP Frame (SAS only) 94
SCSI Command (SAS only) 95
FIS (Frame Information Structure) (SATA only) 96
FIS Pattern (SATA only) 97
ATA Command Pattern 98
Soft Reset (SATA only) 98
Sequential Trigger Mode 99
Timer 99
Defining Patterns 100
Triggering Order 100
Pre-Trigger 101
2.6.17 Project Settings 101
2.6.18 Memory Settings 102
Trigger Position 102
Trace File Name 103
Auto Run 103
Memory Size 103
Partial Memory 103
Segmented Memory 103
Upload Manager 103
2.6.19 Analyzer Settings 104
Primitive Response Timeout 104
Disable Descrambling 104
Show XXXX value 105
ALIGN Transmission Period (differs for SAS and SATA) 105
Power Management Setting (SATA only) 105
Protocol Error Mask 105
External Trig Out Setting 106
External Trig In Setting 106
Choose Port Speed 106
Ports Configuration 106
Port Configuration and Projects 108
MUX Setting (SAS only) 109
2.6.20 Add a Project Note 110

2.7 Advanced Mode (User-Defined) 111
2.7.1 Working in Advanced Mode 111
State Number for Complex Trigger Sequences 113
Setting Trigger Conditions 113
2.7.2 Multi-Link Triggering 115
2.7.3 Set Timers 115
2.7.4 Timeout 115
Useful Key Sequences 118
2.8 Project Settings 119
2.8.1 Notes 119
2.9 Emulation 119
2.9.1 Programming the Initiator or Host Emulator 119
Add Program Lines 120
2.9.2 Adding Initiator or Host Emulator Commands 120
Adding an ATA Command 120
Adding a User-Defined ATA Command 122
Adding a SCSI Command (SAS only) 122
Adding a User-Defined SCSI Command (SAS only) 123
Adding a TASK Command (SAS only) 124
Adding an SMP Command (SAS only) 125
Adding a Frame 126
Adding an Event 127
Power On 128
PHY Setting Dialog 129
Inserting Instructions 129
Phy Reset Sequence and Identification 133
Sample Host Emulator Program (SATA only) 133
Sample Initiator Emulator Program (SAS only) 134
Data Blocks 134
Exercising Specific Addresses 134
2.9.3 Record and Play 136
2.9.4 Error and Command Settings 139
ATA Error and Command Settings 139
Outgoing ATA Frame Settings 142
Incoming ATA Frame Settings 144
SCSI Error and Command Settings (SAS only) 145
Outgoing SCSI Frame Settings 147
Incoming SCSI Frame Settings 149
FIS Options (SATA only) 149
2.9.5 Initiator Setting Tab (SAS only) 150
2.9.6 Host Setting Tab (SATA) 156
2.9.7 Project Settings 161

2.9.8 Creating a Data Block 161
Naming a Data Block 163
Editing a Data Block 163
Creating and Editing Data Blocks as Text 166
2.10 Performance Analysis 167
2.10.1 Performance Analysis with Analyzer Only 167
New Performance Analysis Project 167
Last Saved Performance Analysis Project 167
2.10.2 Performance Analysis Project 167
Define Performance 169
Settings 169
2.11 Run Hardware 172
2.12 Target and Device Emulation 172
2.12.1 Pages Tab 172
Words with Settable Bits 174
Writable Buffer Size Field 175
Error Injection Tab 175
2.12.2 Setting General Errors 176
Generate Periodic Error 177
Outgoing FIS Command Error or Outgoing FRAME Command Error 177
Identify Errors (SAS only) 180
2.12.3 Connection Management (SAS only) 180
Open Connection Definition 181
Close Connection Definition 182
2.12.4 SAS Commands Errors (SAS only) 182
Outgoing Frame Settings 184
2.12.5 ATA Commands Errors (SATA only) 187
2.12.6 Outgoing Frame Settings 188
2.12.7 Incoming Frame Settings 189
2.12.8 SATA Signature (SATA only) 190
2.12.9 SATA Signature Errors 191
2.12.10 User-Defined Commands Tab 192
2.12.11 Target Emulator Settings (SAS) 193
2.12.12 Notes Tab 197
2.12.13 Run Target Emulation 197
2.12.14 Device Emulator Settings (SATA only) 197
2.12.15 Project Note 204
2.12.16 Using the Power Expansion Card 204
2.12.17 Run Device Emulation 204

Chapter 3: Display Manipulation 205

3.1 Viewer Display 205
3.1.1 Quick View 206

3.1.2 Using the Viewer Display 207
3.2 Trace Properties 207
3.3 Analysis 208
3.3.1 Show Analysis Toolbar 208
3.3.2 Decoding Assignments 210
3.3.3 Packet View 210
Packet View Metrics 211
Copying Packets from a Trace to a Host Emulator Script 212
Device Sleep (DevSlp) 213
3.3.4 Changing the Default View 213
3.3.5 Spreadsheet View 214
Save As Text/Excel 215
Change Format of Logical Block Address (LBA) 215
3.3.6 Column View 215
3.3.7 Text View 216
3.3.8 Frame Inspector View 217
3.3.9 Waveform Display 218
3.3.10 Statistical Report 219
Generating Statistical Read/Write Report 220
Report between Cursors 221
Report between Events 222
Statistical Report Content 222
Report Options 223
General Report 223
Primitive Report 223
Bus Condition Report 224
ATA Command Report 224
Time out of ATA Command Report 225
ATAPI Report 225
Protocol Error Report 226
Others Report 226
SSP Transport Report (SAS) 226
SMP Transport Report (SAS) 227
SCSI Command Report (SAS) 228
SMP Command Report (SAS) 228
Task Command Report (SAS) 228
SAS Address Report (SAS) 229
Lanes Report (SAS) 229
Read/Write Command Report (SAS) 230
Performance Report (SAS) 230
Performance Report (SATA) 231
FIS Report (SATA) 232
Queue Command Report (SATA) 232

PM Statistic Report (SATA) 233
PM Performance Report (SATA) 233
Read Write Command Report (SATA) 234
3.3.11 Statistical Report Toolbar 234
Export as Microsoft® Excel file 235
Save as Text file 235
Print Statistical Report 235
Print Preview 235
Report Display Settings 236
Link With Sample View 237
3.3.12 Formatting the Statistical Report View 237
Filtering Column Content 237
Sorting Column Content 239
Hiding Columns 239
3.3.13 Histogram View 240
Hide Frames 240
Hide Error Frames 240
Pending IO Graph 241
User Defined 241
Primitives 241
Zoom 242
3.3.14 Bus Utilization View 242
3.3.15 Bus Utilization Buttons 243
3.4 Data Report 243
3.4.1 Data Payload View 244
3.4.2 Compare Two Data Payloads 246
3.4.3 Power Tracker View (SATA only) 247
3.4.4 SAS Verification (SAS) 248
3.4.5 Compliance Test (SATA) 250
3.4.6 Running Verification Script Engine (VSE) 252
3.5 Navigation + View Toolbar 256
3.5.1 Go To Menu 257
Locate Cursors 257
Go to Time Stamp 258
Bookmarks 258
Editing a Bookmark 259
Finding a Bookmark 259
Bookmark Description 260
Set Time Stamp Origin 261
3.5.2 Filtering 261
3.5.3 Filter Setup 261
Filter Type 263
Filtering Direction 263

Filter Idle 263
Save Filter Setup 263
Filter Logic 263
Multilevel Filtering in SAS 263
Filter descending packets from trace highlight bar 265
3.5.4 Selectable Filter Options for SAS 265
Command Data Pattern 266
Bus Condition 266
Incomplete Frames 266
ATA Command 266
Protocol Error 266
ATAPI SCSI Command 266
Filter Check Condition 266
Filter by Tag Number 267
Use Pair SAS Addresses 269
Training Sequence 269
3.5.5 Selectable Filter Options for SATA 269
Bus Condition 270
3.5.6 Enable Filter 270
3.5.7 Filter Idle 270
3.5.8 Search 271
Save Search Setup 272
Search By 272
Search Direction 272
Search From 272
Search Logic 273
Search For 273
Search Domain 273
Search Sub Items 274
3.5.9 Show/Hide Ports 275
Single Port 275
Multiple Ports 275
3.6 Packet View Toolbar 276
3.6.1 CATC Navigation View 277
3.6.2 Spec View 278
3.6.3 Decode Icons 279
3.6.4 Customize Display 280
Rename Port 280
Show/Hide Field 280
Related Frames 281
Byte Order 282
Choose Data Format 282
Show All Data 283

3.7 Port Status 284
3.8 Toolbars 286
3.8.1 Enabling Tool Bars 286
3.8.2 Cursor Position Status Bar 286
3.9 Status Bar 287
3.9.1 Search Status 287
3.10 Using the Cursors and Bookmarks 287
3.10.1 Cursors 287
3.11 Display Configuration 288
3.11.1 Trace Viewer Configuration 288
3.12 Set Port Alias 292
3.13 SAS Address Alias (SAS only) 293
3.14 TxRx Vout & Preemphasis 294
3.15 Preferences 296
3.15.1 General Tab 296
Paths 296
Template Files 296
Other 297
Found Device List Mode 297
Browse Default Path 297
3.15.2 Trace Viewer Tab 298
Open Trace file In 298
Optimization 298
Other 299
3.15.3 Spread Sheet View Tab 301
Color Setting 302
Anchor the Selection bar 302
Other 302
3.15.4 Column View Tab 303
Other 303
3.15.5 Sampling Memory Usage Optimization 303
If the Sampling Memory Usage Optimization Option is Checked 304
If the Sampling Memory Usage Optimization Option is Not Checked 305
3.16 Floating License 305
3.17 External Trig Setting 306
External Trig Out Setting 306
External Trig In Setting 307
3.18 Update Device 307
3.19 User-Defined Decoding 309
3.20 Help Menu 309
3.20.1 Help Topics 309
3.20.2 VSE Help Topics 310
3.20.3 Update License 310
3.20.4 Display License Information 310

3.20.5 Check for Updates 312
3.20.6 About 312
3.21 Setup Menu 312
3.21.1 Self Test 312
3.21.2 Clock Check 313
3.21.3 Memory Check 314
3.21.4 Serdes Check 315
3.21.5 Crosspoint Check 316
3.21.6 Main FPGA Check (SATA only) 317
3.21.7 Expansion Check 318
3.21.8 LED/Buzzer Check 319
3.22 Find DUT 320
Aliasing 322
Exporting 322
3.23 Power Source Control 322
3.24 Compliance Test (SATA) 323

Chapter 4: InFusion Overview 327
4.1 Key Features 328
4.2 Interface 329
4.2.1 Buttons 329
4.2.2 Menus 330
File 330
Setup 330
View 330
Configuration 330
Tools 330
Help 331
4.2.3 Main Library 331
4.2.4 File Library 331
4.2.5 Device Ports 332
Using the Device Ports Dialog 332
4.3 Port Configuration for InFusion 333
4.4 InFusion Scenarios 336
4.4.1 Scenarios Overview 336
InFusion Scenario Parameters 337
4.4.2 Global Rules 338
Sequences 339
4.5 Scenario Libraries 340
4.5.1 Main Library 340
4.5.2 File Libraries 340
4.5.3 Device Libraries 341
4.6 Scenario Properties 341

SATA Smart Hold Option ... 343
4.7 Scenario Events ... 344
DWORD Matcher ... 347
SAS Data Pattern ... 347
SATA Data Pattern ... 347
4.8 Scenario Actions ... 348
Using Counters in Events and Actions ... 350
Capturing a Data DWORD ... 351
Using Captured Data DWORDs ... 351
4.8.1 Summary of Scenario Creation ... 353
4.9 Creating Global Rules ... 353
4.9.1 Example 1: Creating a Single Event and Action that Removes a Primitive ... 354
4.9.2 Example 2: Wait for a Primitive and Replace It with an Error ... 356
4.9.3 Example 3: Creating OR Conditions ... 357
4.9.4 Example 4: Multiple Triggers and Actions ... 359
4.9.5 Example 5: Multiple Actions on a Single Event ... 361
4.9.6 Example 6: Using Timers ... 362
4.10 Creating a Sequence ... 364
4.10.1 Example 7: Creating Two Sequences and Global Rules ... 365
4.11 Example 8: Creating a Sequence With Many States #1 ... 370
4.12 Example 9: Creating a Sequence With Many States #2 ... 373
4.13 Downloading Scenarios ... 376
4.14 Running Scenarios ... 377
4.15 Scenario Batch Files ... 377
4.15.1 Script Workspace ... 377
4.15.2 Error Checking ... 380
4.15.3 Log ... 380
4.15.4 Statements ... 380
IfIsStopped ... 380
Goto Label ... 381
Run ... 382
Stop ... 383
WaitForStop ... 384
Sleep ... 385
Beep ... 385

Chapter 5: Sierra Trainer Traffic Generation ... 387
5.1 Sierra Trainer Menus ... 387
5.1.1 File Menu ... 388
5.1.2 Setup Menu ... 388
5.1.3 Generate Menu ... 389
5.1.4 Search Menu ... 390
5.1.5 View Menu ... 390

5.1.6 Tools Menu 391
5.1.7 Window Menu 391
5.1.8 Help Menu 392
5.2 Sierra Trainer Main Toolbar 392
5.3 Setting Up for Generating Initiator Traffic 393
5.4 Setting Up for Generating Target Traffic 393
5.5 Creating a Traffic Generation File 393
5.5.1 Creating a New Generator File 393
5.5.2 Editing an Example Generation File 394
5.5.3 Converting an SATrainer Traffic Generation File 395
5.6 Opening a Traffic Generation File 396
5.6.1 Layout 397
5.7 Overview of Generation and Global Settings Files 397
5.7.1 Traffic Generation (*.ssg) Files 397
5.7.2 Settings.inc File 398
5.7.3 The Global Setting “AutoAlign” 399
5.7.4 Placing Global Settings in the Generation Block 399
5.8 Primitive and Frame Definitions 401
5.8.1 Special Conditions for Frames 401
5.8.2 Primitives Decl.inc File 402
5.8.3 Address FramesDecl.inc File 402
5.8.4 SSPFrames.inc File 402
5.8.5 SMPFrames.inc File 402
5.8.6 STPFrames.inc File 402
5.9 Starting the Script Editor 402
5.9.1 Script Editor Toolbar 403
5.9.2 View Options Menu 404
5.9.3 Pop-up Menu 405
5.9.4 File Tabs 405
5.9.5 Error Log 405
5.9.6 Tooltips 405
5.10 Multi-Port Trainer Script Assignments to Links 406
5.11 Generating Traffic 407
5.11.1 Stop Traffic Generation 408
5.11.2 Resume Traffic Generation 408
5.12 Sierra Trainer Generation Language 408
5.12.1 File Structure 408
5.12.2 Language 409
Comments 409
Includes 409
5.12.3 Settings 409
5.12.4 Constants 409
5.12.5 Predefined Constants 409
5.12.6 Data Patterns 410
5.12.7 Primitives 410

5.12.8 Packets/ Frames 412
5.12.9 Generation Block 414
5.12.10 Definitions 414
Field Variable Declarations 414
Changing Frame Fields 414
Preprocessor Integer Arithmetic 415
5.13 Trainer Script Enhancements 416
5.13.1 Variable Definition 417
5.13.2 Assigning Variable Values 417
5.13.3 Expression on Variables 418
5.13.4 If/While in Logical Expressions 418
5.13.5 Using Variable Values in Creating Patterns on Bus 420
5.13.6 Timer 421
5.13.7 PATTERN Counter 421
5.13.8 Procedure Definition 422
5.14 Sierra Trainer Generation Commands 422
5.14.1 General Commands 422
5.14.2 SATA Commands 424
5.14.3 Primitive Commands 425
5.14.4 Primitive Category 427
5.14.5 Wait Commands 428
5.14.6 Wait Command Groups 435
5.14.7 Predefined Constants 438
5.14.8 Generation Settings 439
5.15 Generation Options 447
Generation Rules Toolbar 448
Generation Rules Page: How It Works 449
Creating Event Buttons 449
Dragging a Button to the Main Display Area 450
Assigning an Action 451
5.15.1 Generation Rules Pop-Up Menus 451
5.15.2 Cell Pop-up Menu 452
5.15.3 Action Pop-up Menu 452
5.15.4 Event Pop-up Menu 452
5.15.5 Events and Event Properties 453
Data Pattern Mask and Match 453
5.16 Setting Complex “Wait For” Conditions 454
5.16.1 Setting Conditions with the Generation Options Dialog 454
5.17 Find 455
5.17.1 Data Pattern Mask and Match 458
5.17.2 Find Next 458
5.17.3 Search Direction 458
5.18 Display Options 459
5.18.1 Color/Format/Hiding Display Options 459

5.18.2 Color Display Options 460
5.18.3 Formats Display Options 461
5.18.4 Hiding Display Options 462
5.18.5 Level Hiding Options 462
5.18.6 Headers Options 463
5.18.7 Saving Display Options 464
5.19 Connection Parameters 464
5.20 Resetting the Toolbar 465

Appendix A: Creating a Pattern Generator File 467
6.1 Key words 467
6.2 Comment format 467
6.3 Primitive definition format 467
6.4 Loop definition format 467
6.5 Scramble definition format 467
6.6 Role definition format 467
6.7 END_OF_FILE definition 467
6.8 Example Pattern Generator File 468

Appendix B: China Restriction of Hazardous Substances Table 469
7.1 WAN Operation 470

Appendix C: How to Contact Teledyne LeCroy 471

Index: 473

Chapter 1

Introduction

This manual describes installation and operation of the Teledyne LeCroy Sierra M6-2™ Protocol Analyzer and includes examples of typical applications.

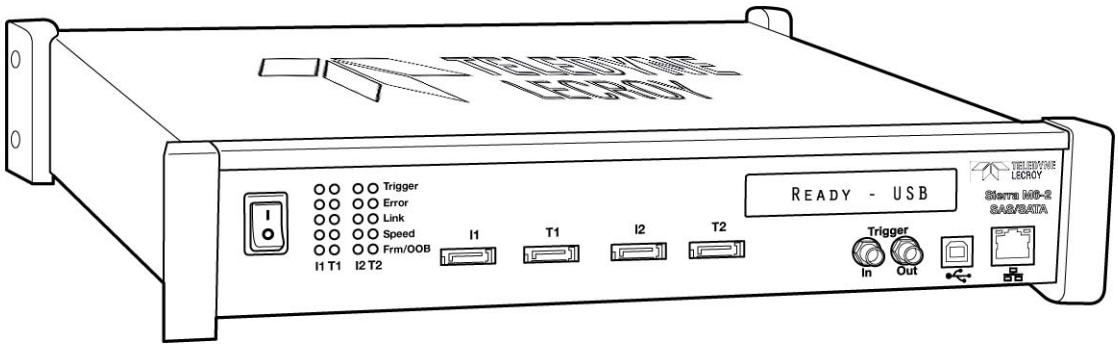


Figure 1.1: Teledyne LeCroy Sierra M6-2 Protocol Analyzer

1.1 Analyzer Overview

The Sierra M6-2 SAS/SATA Protocol Analyzer is a serial bus analyzer, supports host and device emulation, generates traffic, and provides error injection functionality. The SAS analyzer software performs serial bus analysis for Serial Attached SCSI (SAS) data transfers, as well as Serial ATA (SATA) data transfers through STP data transfers. The SATA analyzer software performs serial bus analysis for Serial ATA (SATA) data transfers.

The Sierra M6-2 Analyzer helps Hardware, Firmware, Design, and Application Engineers troubleshoot and diagnose SAS and SATA problems within their product. The analyzer supports the following:

- Capture, triggering, and filtering of Serial Attached SCSI packets or Serial ATA packets
- Generation of bus traffic as a SAS Initiator Emulator or a SATA Host Emulator, while monitoring and analyzing results
- SAS target emulation and SATA device emulation
- Running a Pattern Generator
- TX Vout on transmitters for test and characterization
- CATC API

The analyzer provides for bi-directional trigger and capture of commands, primitives, patterns and all bus conditions. You can capture all frames and/or exclude traffic.

The InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool that allows you to verify real-world fault handling.

The Trainer is a traffic generator that can emulate a SAS initiator/target or SATA host/device.

The Sierra M6-2 Analyzer has a USB port and an Ethernet port to connect to a computer. You can cascade analyzer units for higher port counts. The analyzer allows you to select frames to include and exclude for capture. Capturing can be triggered based on a specific event or manually.

The Sierra M6-2 Analyzer provides a full range of views and statistical reports.

1.2 Features

- 6 Gb/s SAS/SATA protocol analysis or error injection
- Native PHY for fast lock time
- Easy mode triggering
- Cascade up to 8 analyzers
- Sync with Teledyne LeCroy Sierra and STX family products
- CrossSync Control Panel
- Hardware filtering
- Automatic error detection
- Comprehensive decoding of SAS and SATA data traffic
- Logical and chronological traffic displays
- Statistical reporting
- Trace memory of 4 GB or 8 GB
- GbE & USB 2.0 host interfaces
- Capture, triggering, and filtering of Serial Attached SCSI packets or Serial ATA packets
- TX Vout on transmitters for test and characterization
- Automation API
- Error Injection Functionality (Jammer)
- Emulation support
- Trainer traffic generation

1.3 Receiving Your Analyzer

The analyzer package includes the following components:

- 1 Sierra M6-2 Analyzer identified in the packing list
- 2 SATA cables, 0.5 meter
- 1 USB A-B 2.0 cable, 1.8 meter
- 1 Ethernet cable, 10 feet
- 1 10-position ribbon cable, 6 inches
- 1 SMB RA to SMB RA cable, 6 inches
- 1 Three-Prong AC power cord
- 1 Installation CD ROM with software and documentation
- 1 Sierra M6-2 Getting Started manual

1.4 Unpacking the Analyzer

Inspect the received shipping container for any damage. Unpack the container and account for each of the system components listed on the accompanying packing list. Visually inspect each component for absence of damage. In the event of damage, notify the shipper and Teledyne LeCroy Corporation. Retain all shipping materials for shipper's inspection.

1.5 Analyzer Features

The Analyzer has the following features:

- Power Switch (0/1)
- Trigger, Error, Link, Speed, and Frame/OOB LEDs (see next page)
- Port 1 Initiator/Host SATA connector
- Port 1 Target/Device SATA connector
- Port 2 Initiator/Host SATA connector
- Port 2 Target/Device SATA connector
- Status and Configuration LCD Display
- External Trigger Input and Output
- USB port for host connectivity
- Gigabit Ethernet port for network connectivity
- Power In (on back)
- Expansion In/Out data ports and Clock In/Out connectors (on back)

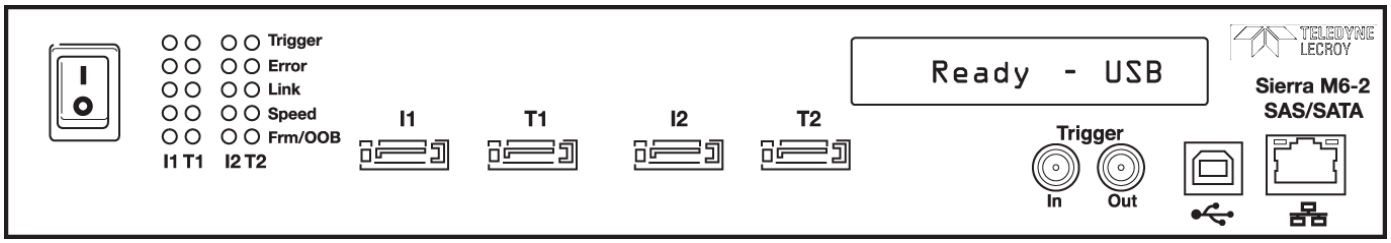


Figure 1.2: Front Panel

1.6 LEDs

Each link is supported by LEDs with the following functionality:

GreenThis LED is illuminated during the OOB (Out of Bound) sequence before the link is established and after link is established it indicates traffic on the bus.

Orange This LED is illuminated as follows:

Speed	Initiator	Target
1.5G	Off	Off
3.0G	On	Off
6.0G	On	On

Yellow This LED is illuminated when a link is established.

Red This LED illuminates when an error occurs.

Blue This LED is illuminated when a trigger occurs.

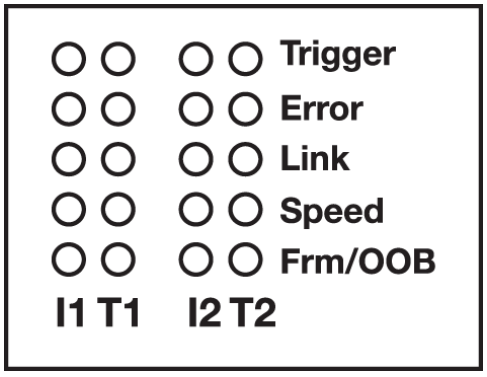


Figure 1.3: LEDs

1.6.1 Status and Configuration Display

The Analyzer front LCD display indicates the configuration and status of operations. For example, during initialization, the LCD panel displays boot status messages.

1.7 Installing Your Analyzer

1.7.1 Software Installation

The SAS and SATA software works on systems using the Windows® XP, Windows 7 (x86, x64) Windows 8 (x86, x64), Windows Server 2003, Windows Server 2008 and Windows Server 2012 R2 operating systems. 64-bit Windows OS is recommended because it allows using more RAM memory. Other Operating Systems limit the RAM to 3GB.

Insert the Installation CD ROM into the CD/DVD drive on the host machine.

1. The installation automatically starts setup, unless Auto Run is off. In that case, select the CD ROM from “My Computer” and click **Setup**.
2. After the warning to close all other programs and before starting the installation, the Install component selection opens.
3. Select components for installation.
4. Click **Next** to complete the installation.

System restart

You must restart your computer before you can use your Analyzer software.

Error Message

If you get an error message during installation of the drivers for Window, consult your system administrator. Your system may allow only administrator-level users to copy such driver files.

1.8 Hardware Setup

1.8.1 Separate Systems

When using the analyzer, it is recommended to use a system to generate bus traffic and a second system to run the software, to avoid characterization of traffic generated by the analyzer.

1.8.2 Connecting in General

Note: You must install the software before connecting the analyzer to the host machine for the first time.

To set up the analyzer:

1. Plug the power adapter into the unit, and then plug the power adapter into a 100V–240V, 50Hz–60Hz, power outlet. Turn on the Power switch.
   At power on, the analyzer will go through initialization as shown on the LCD display.
2. Connect the USB cable between the Sierra M6-2 USB port and a USB port on the host machine. The host machine operating system detects the analyzer and driver files.
   (See “Connecting via Ethernet” on page 34 for Ethernet connectivity.)
3. Connect the analyzer as shown in Figure 1.4: .

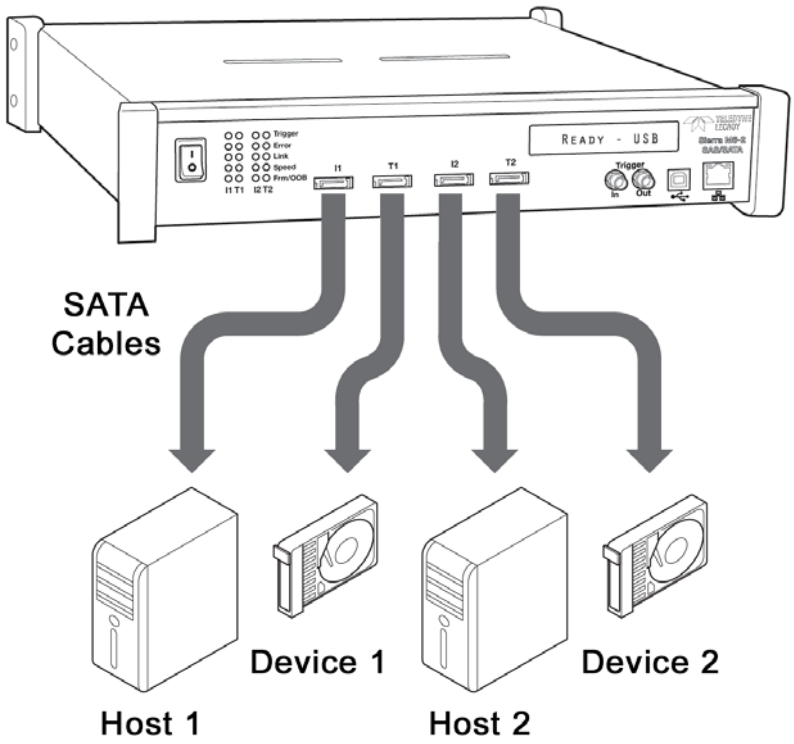


Figure 1.4: Analyzer Connections

1.8.3 Cables to Use

When using Sierra as a Host Emulator, connect from Target to hard drives using a SATA cable.

When using Sierra as a Device Emulator, connect from Initiator to HBAs using a SATA cable.

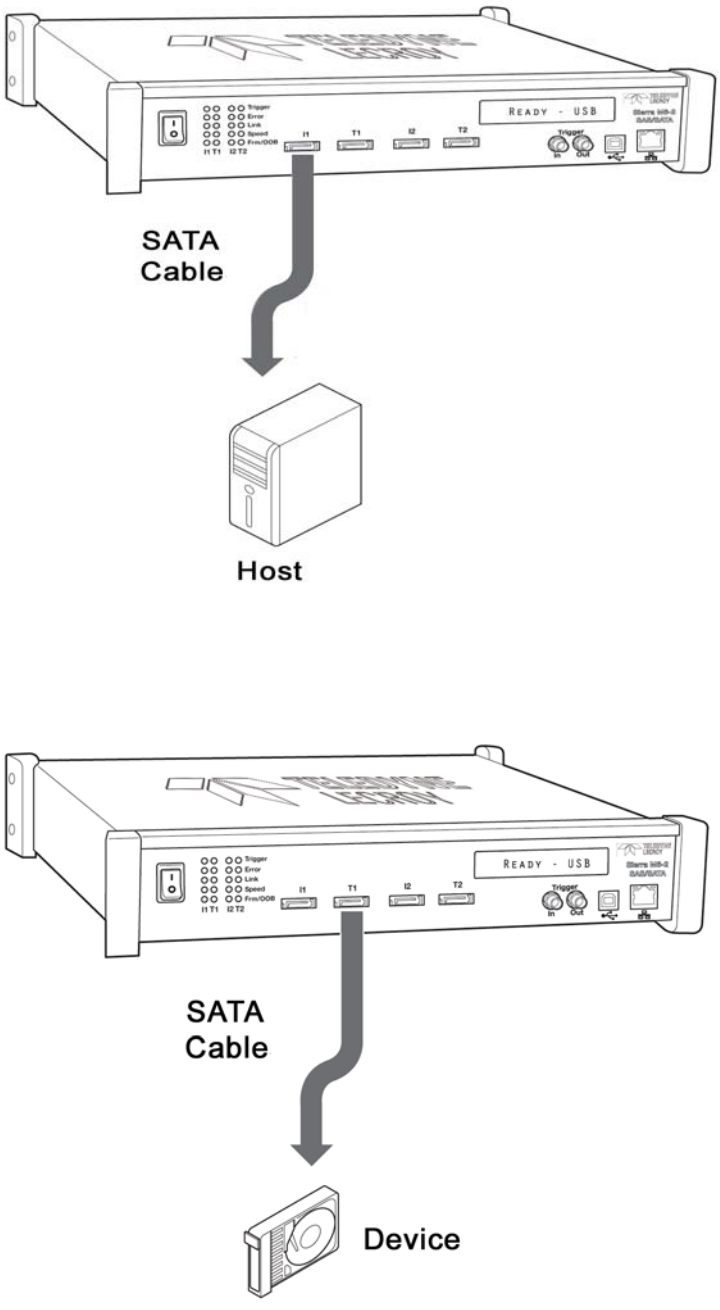


Figure 1.5: Sierra M6-2 Connected as an Analyzer

1.9 Expandability

You can expand by:

- Cascading with STX SYNC Expansion Cards
- Cascading with CATC SYNC Expansion Cards
- Using the Power Expansion Card

You can remove expansion cards with two simple tools.

Cascading and Memory Size
For example, you have two units. The first one has 2 GB memory. The second one has 4 GB memory. The system shows the entire memory as 6 GB. If you set buffer size to 6 GB, the system programs the first board for 2 GB and the second board for 4 GB. You can consider this ratio when you set buffer size to any value. For example, if you set buffer size to 2 GB, the system programs the first board for (2*2)/6 GB and the second board for (2*4)/6 GB. Any unit that has more memory will have larger buffer size.

1.9.1 Cascading with STX SYNC Expansion Cards

You can use cascading of analyzer units for higher port count, by daisy chaining the units through the provided Expansion and Clock In/Out interfaces on the analyzer back. Connect “Out” connectors to “In” connectors of the next unit in the chain, for both Signal and Clock interfaces. You must provide external hubs for connecting the host machine to these units using USB or Ethernet. You can cascade up to eight units. Use the STX SYNC Expansion Cards to sequentially trigger the State Machine in Advanced mode.

If you mix Sierra M6-4, Sierra M6-2, and STX A6-4 analyzers/emulators, put Sierra boards first, then STX.

Note: Because chain connections for cascading boards cause delay of signals, traffic on different boards is not completely time synchronized, with about one DWORD difference between consecutive boxes.

Cascading

To set up the units in a cascade:

1. Connect all units to the host machine using either USB or Ethernet cables. You can use hubs.
2. Locate the Expansion and Clock ports on the back of each unit.

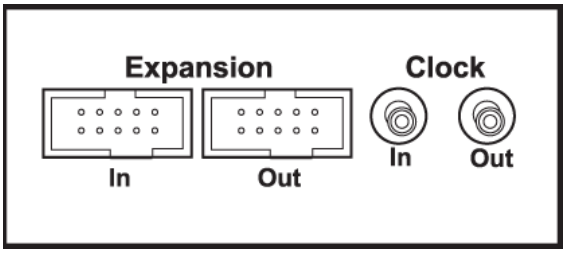


Figure 1.6: Expansion and Clock Ports

3. Connect the OUT Clock connector of Unit 1 to the IN Clock connector of Unit 2 using the supplied stacking cables. Similarly connect any additional units.
4. Connect the OUT 10-pin connector of Unit 1 to the IN 10-pin connector of Unit 2 using the supplied stacking cables. Similarly connect any additional units.

Note: Unit 1 must be the unit that has the first out connection.

Note: The Self Test, SAS Verification Test, SATA Compliance Test and Update License functions only work on unit 1 when the analyzers are set up in cascading mode.

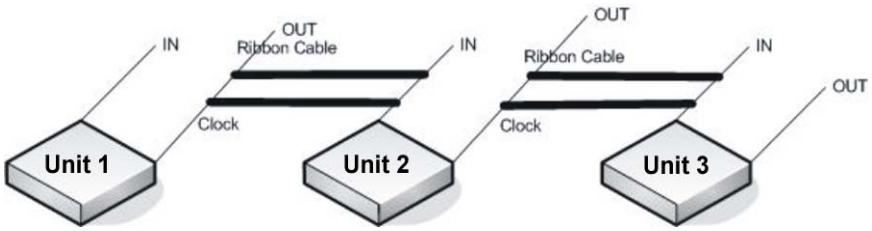
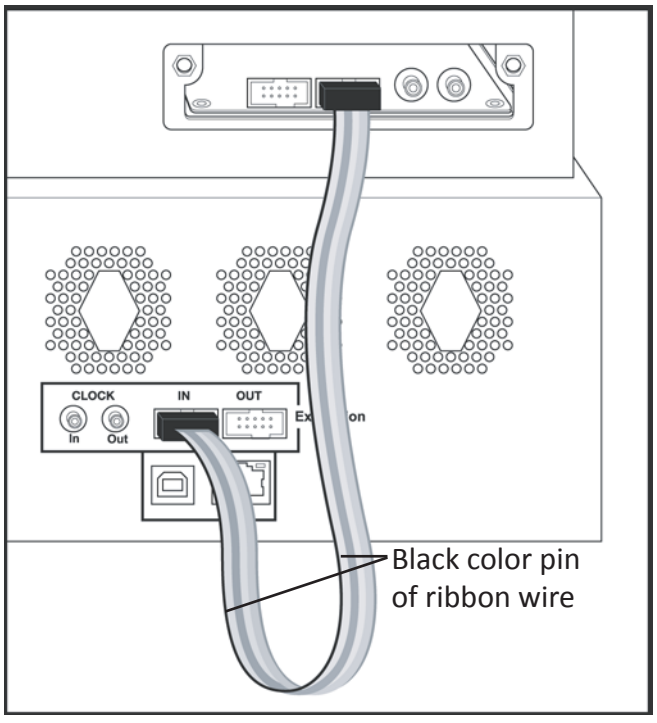


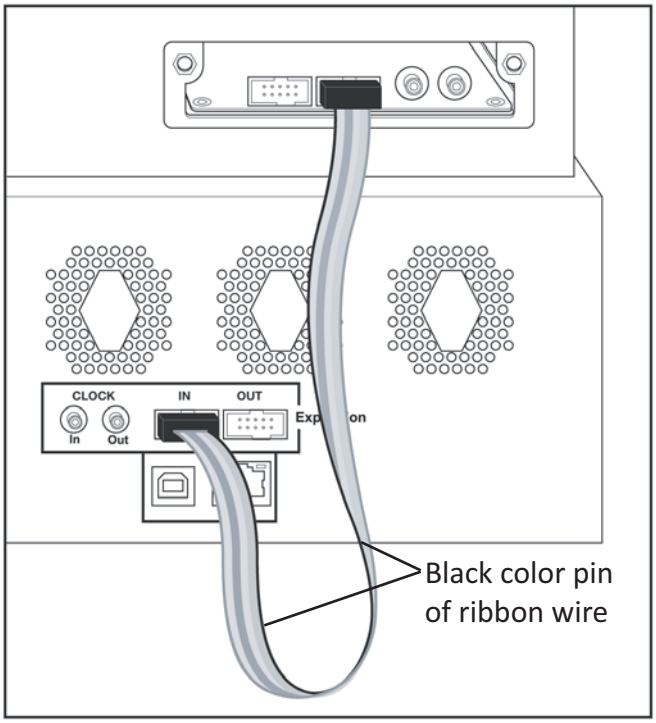
Figure 1.7: Cascading



Correct way to connect:
The black color pin of the ribbon wire is connected the same way between 2 connectors.

Cascading works correctly in this case.

Figure 1.8: Cascading Correctly



Incorrect way to connect:
The black color pin of the ribbon wire is connected in a different way between the 2 connectors.

Cascading works incorrectly in this case, the boxes are connected but no traces are captured.

Figure 1.9: Cascading Wrongly

5. Make a note of the last four digits of the MAC address of the unit designated as Unit 1 and the last four digits of the other units, in order of connection.

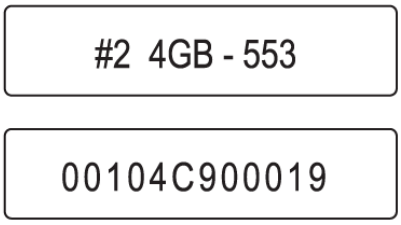


Figure 1.10: Address Digits

IMPORTANT! Power up all units before starting the software.

1.9.2 Select Device

After starting the software, click on **Configuration a**nd select **All Connected Devices** (see the following screen capture).

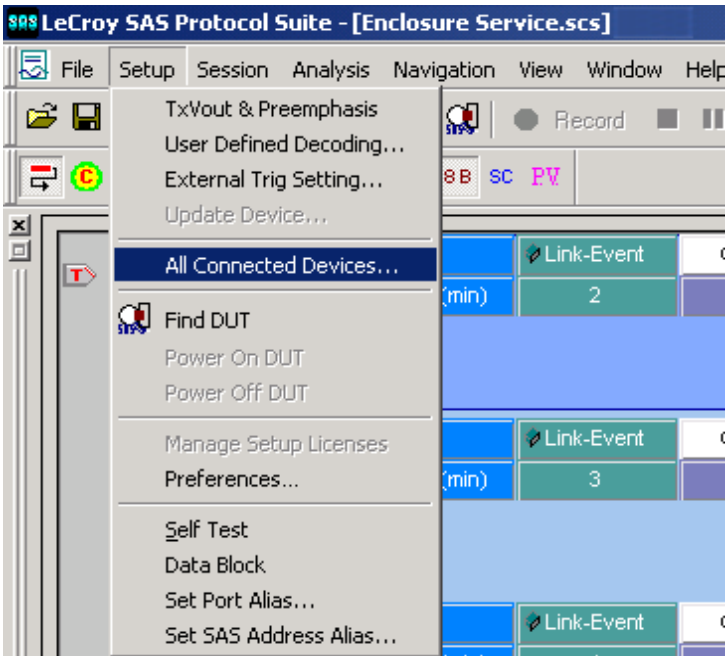


Figure 1.11: Connecting to All SAS Device(s)

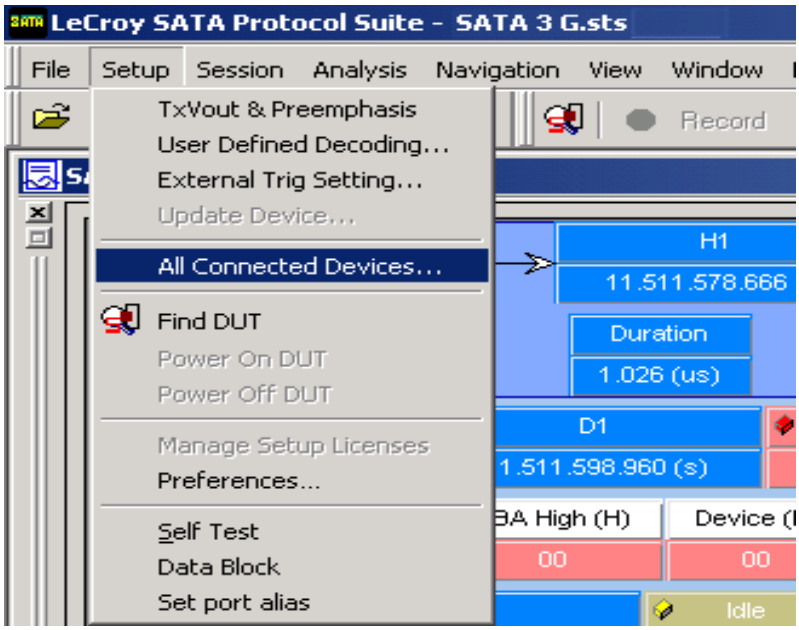


Figure 1.12: Connecting to All SATA Device(s)

The **Select Device** dialog allows connecting and disconnecting analyzers on the fly, without restarting the application.

The new Device List (introduced in version 4.10) mandates using updated firmware in order to detect the analyzer over Ethernet. Thus, the analyzer must be updated over USB before it can be used remotely over Ethernet. This is applicable for any update from version 4.00 or earlier to any version from 4.10 or later.

The following **Select Device** dialog displays. The colors in the 'Location' column mean the following:

- Red: Firmware and/or BusEngine components need to be updated to the latest version
- Light Blue: The device is ready to be connected.
- Yellow: The device is locked.
- Green: The software is connected and ready to run.

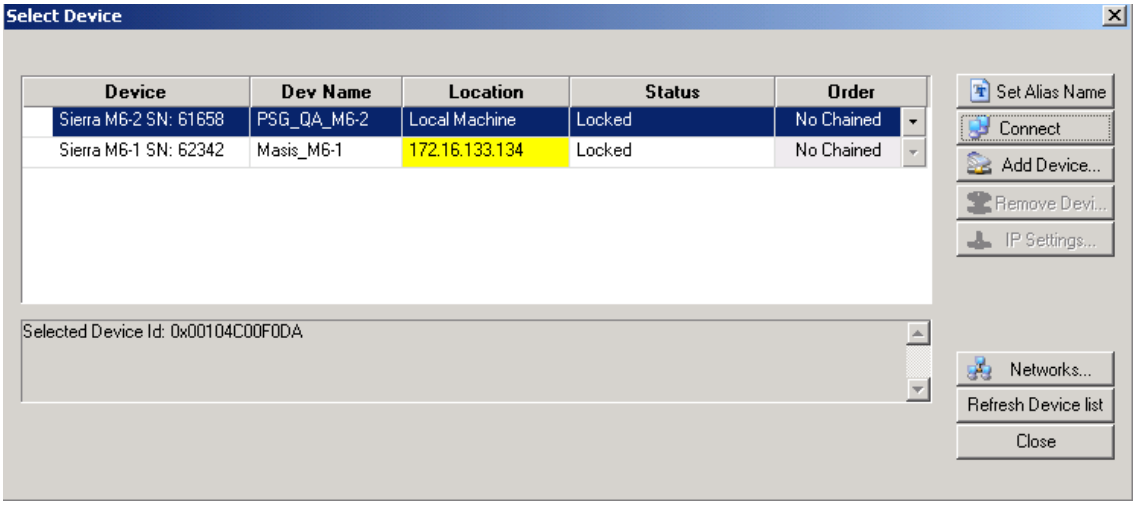


Figure 1.13: Select Device Dialog

Note: Click **Refresh Device List** to display all the devices on the network.

The Select Device dialog displays the following buttons:

Set Alias Name

Click **Set Alias Name** to display the Set device alias name dialog as shown below.

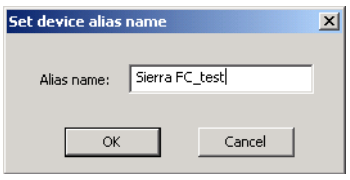


Figure 1.14: Set Device Alias Name Dialog

Disconnect

Click **Disconnect** to disconnect a device.

Add Device...

Click **Add Device** to add a device with a static IP address.

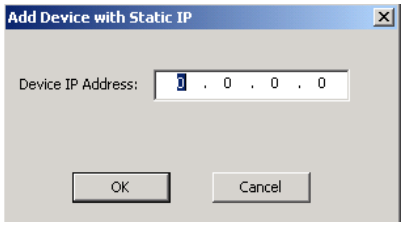


Figure 1.15: Add Device with Static IP Dialog

Remove Device

Click **Remove Device** to remove a previously added device.

IP Settings...

Click **IP Setting** to reset IP settings of a device. The following IP Setting dialog displays.

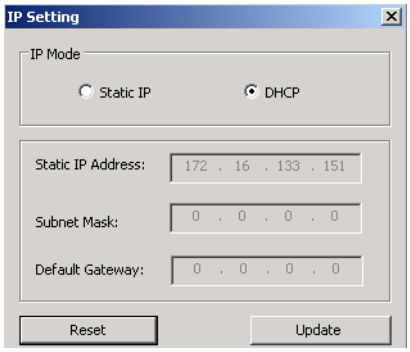


Figure 1.16: IP Setting Dialog

Networks...

Click **Networks** to select a network adapter. The following dialog displays.

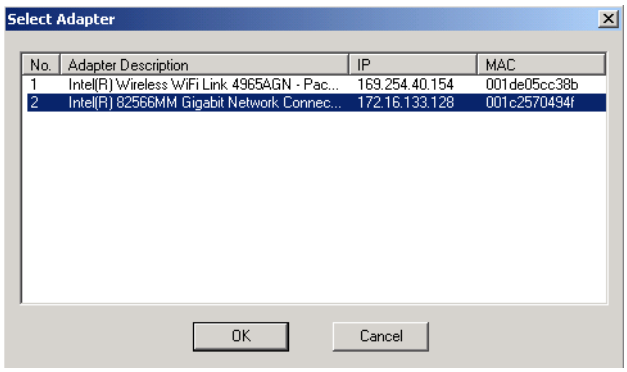


Figure 1.17: Select Adapter Dialog

Refresh Device List

Click **Refresh Device List** to refresh the device list.

To connect to a device, select a device which is Ready to Connect and click the **Connect** button on the right. The Connection Properties dialog is displayed (see the following screen capture).

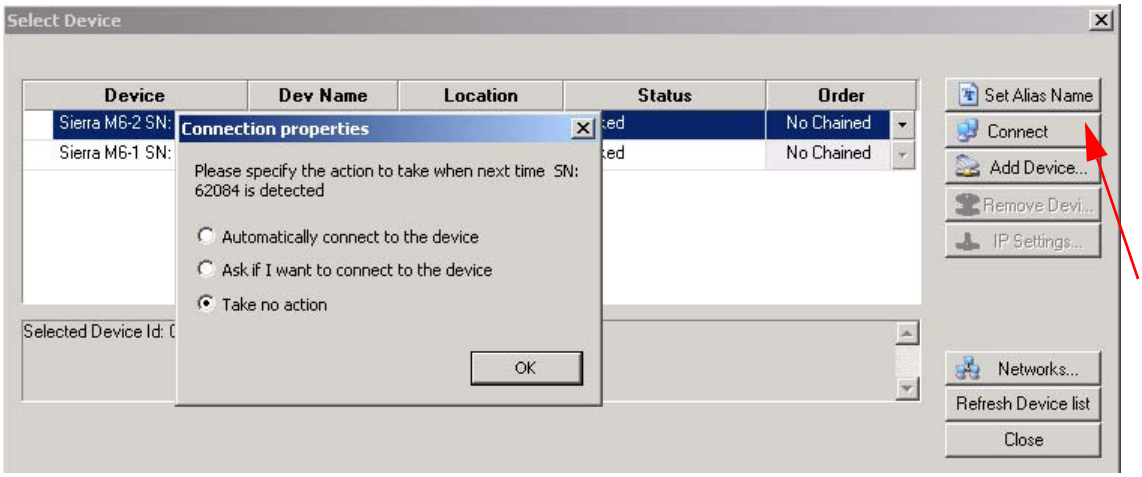


Figure 1.18: Connection Properties Dialog

Specify one of the actions from the following:

- Automatically connect to the device
- Ask if I want to connect to the device
- Take no action

If 'Automatically connect to the device' is selected, the next time the application opens the device will be automatically connected.

In the **Select Device** dialog chained or cascaded units are displayed in the **Device** column with a **[** (square bracket) icon. The sequence of the units is displayed in the **Order** column. See the following screen capture.

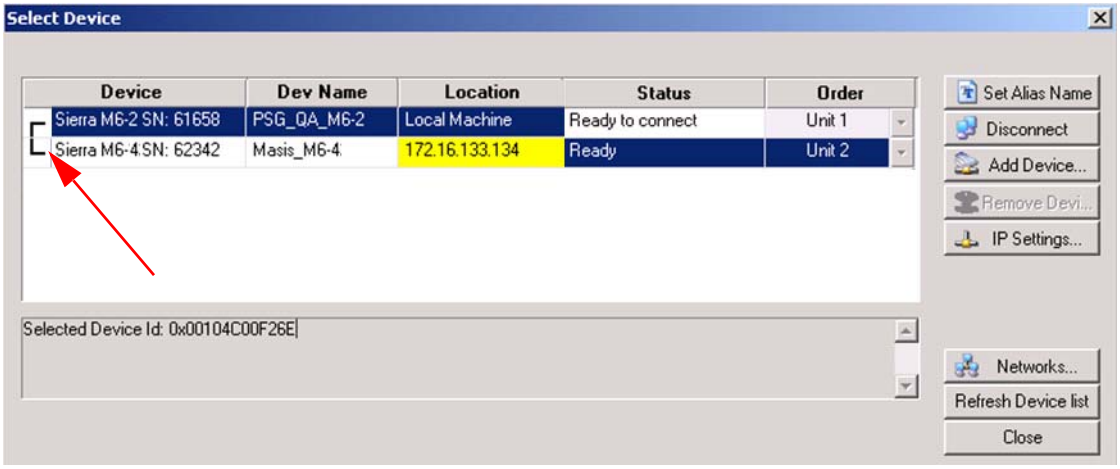


Figure 1.19: Select Device Dialog Displaying Unit 1 and Unit 2 Chained

Note: When using STX Sync cards, you need to manually specify the order of the chained units. To match your unit sequence to the address for each unit in the Select Device dialog, click the pull down tab under the Order heading (on the right side) and select unit numbers: 1 for Unit 1, 2 for Unit 2, and so on. This determines the order in which the cascaded ports appear in the trace. When using the CATC Sync cards the order is automatically detected.

IMPORTANT! Power up all units before starting the software.

1.9.3 Cascading with CATC SYNC Expansion Card

You can cascade up to eight Sierra Analyzers, if they all have a CATC SYNC expansion card.

Note: If Sierra M6-2 has a CATC SYNC Expansion Card, you can cascade with Sierra M6-1. If Sierra M6-2 has an STX SYNC Expansion Card, you cannot cascade with Sierra M6-1.

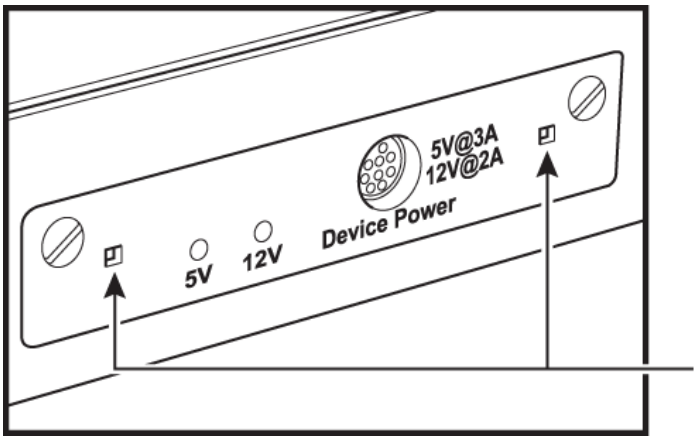
1.9.4 Using the Power Expansion Card

Two types of Power Expansion Cards are available and the type must be specified when ordering the unit.

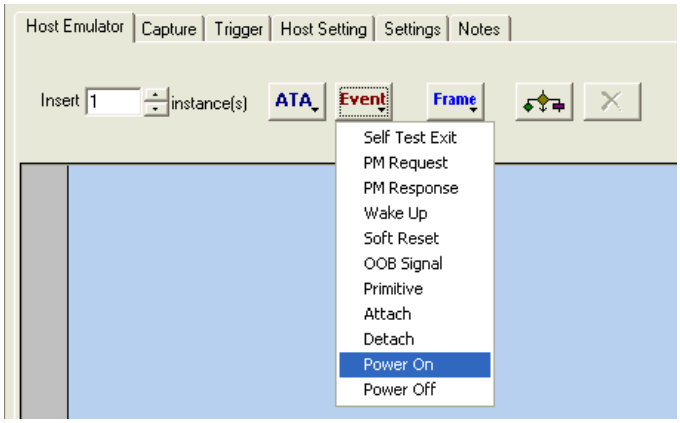
- Power Expansion Card (part number: ACC-EXP-004-X)
- Power Expansion Card 2 (part number: ACC-EXP-005-X)

Power Expansion Card (part number: ACC-EXP-004-X)

You can use the Power Expansion Card to power the drives to test for Emulation, SATA Compliance, and SAS Verification. The Power Expansion Card can supply 5 V or 12 V.



You can turn the card on or off through the software during SATA Compliance or SAS Verification tests.

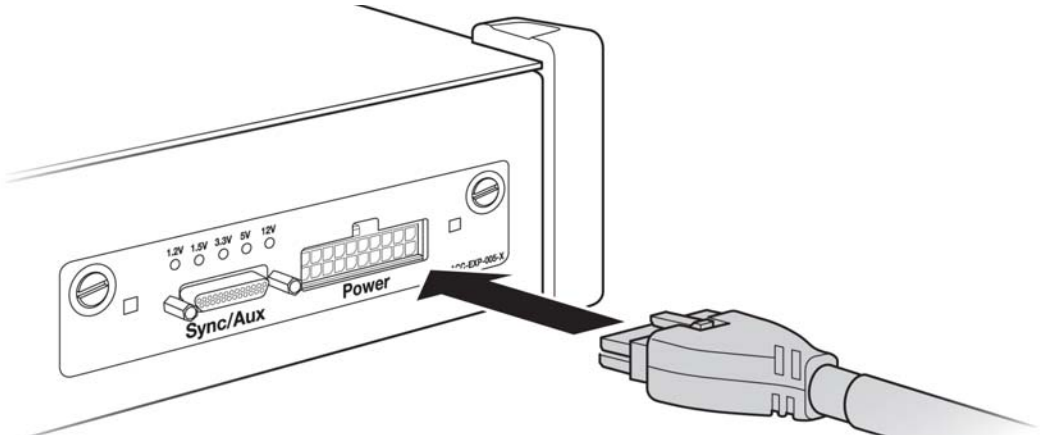


You can turn the card on or off through the BusEngine by user-emulation scripts during Emulation.

Power Expansion Card 2 (part number: ACC-EXP-005-X)

This card has several capabilities:

- Supplies power to devices at 12v, 5v, 3.3v, 1.5v and/or 1.2v. This is controlled by the application (see “Power On” on page 128).
- Allows toggling the new "Device Sleep" (DevSlp) signal to put SATA devices into sleep (see “Adding an Event” on page 127 and Figure 2.103 on page 128).
- Allows monitoring in the trace of the DevSlp signal as generated by the Trainer or Host Emulator, as well as when generated directly from a Host (using a dedicated DevSlp cable). Also see “Device Sleep (DevSlp)” on page 213.
- Allows CATC Sync functionality to enable cascading, so there is no need to toggle between the Power Expansion Card and the Sync Expansion Card.
- Allows power measurement to monitor and record the power, current and voltage being used by the device it powers (will be supported in a future software release).



It is shipped with the following three cables:

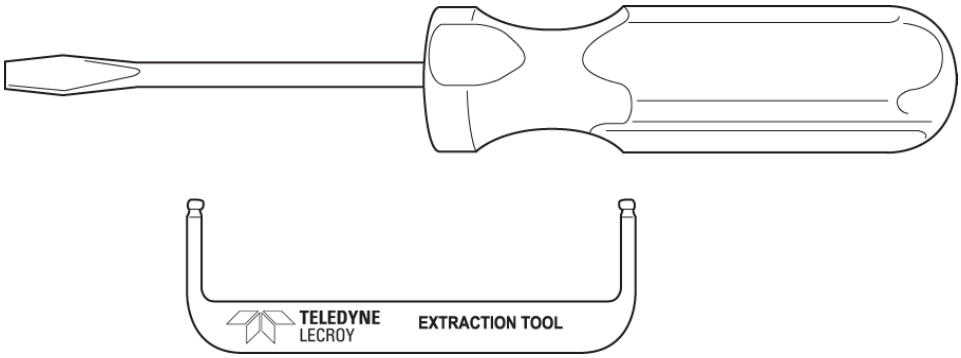
- Standard 4-pin power connector (ground, 5v, 12v only): This is a direct replacement for the existing Power Expansion Card cable.

- SATA 15-pin power segment connector: This plugs in to the power segment of the standard SATA connector, allowing to control and monitor its power and DevSlp.
- DevSlp cable: This cable is used to monitor DevSlp levels when the Device is connected directly to the Host. It is up to the user to supply a copy of the DevSlp signal coming from the Host to connect to the DevSlp wire of this cable, as well as to connect the adequate ground wire of this cable.

1.9.5 Removing Expansion Cards

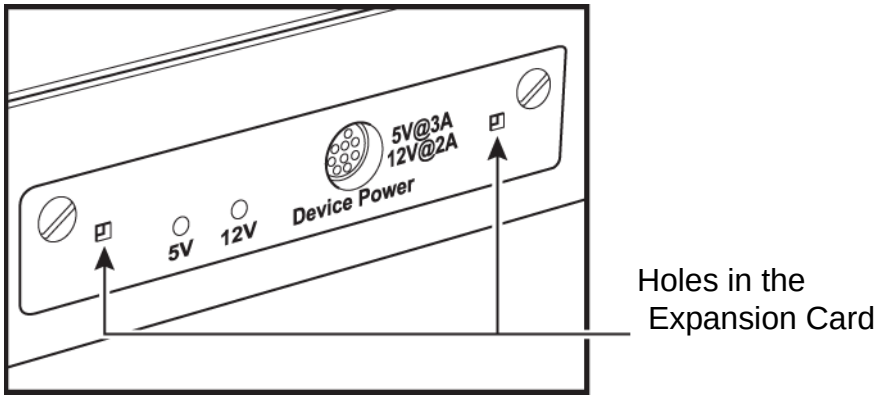
You can remove both expansion cards using two tools:

- Standard (flat blade) 3/16” screwdriver
- Teledyne LeCroy Extraction Tool (part number 230-0160-00)



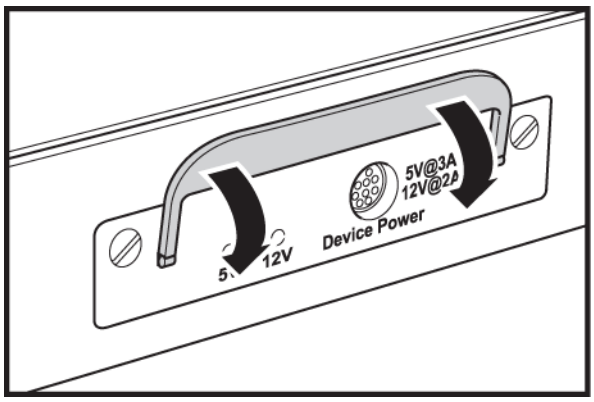
To remove an expansion card, follow these steps:

1. Unplug the system from AC power and turn the system so the expansion port is facing you. Note the two retaining screws and the holes for the extraction tool that are located on the panel of the expansion card.

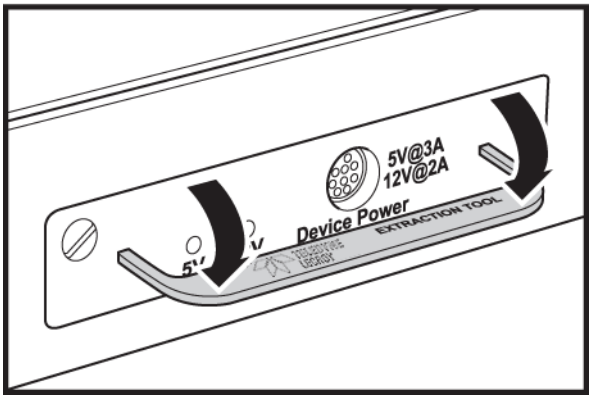


2. Insert the extraction-tool prongs into the holes in the expansion card panel.

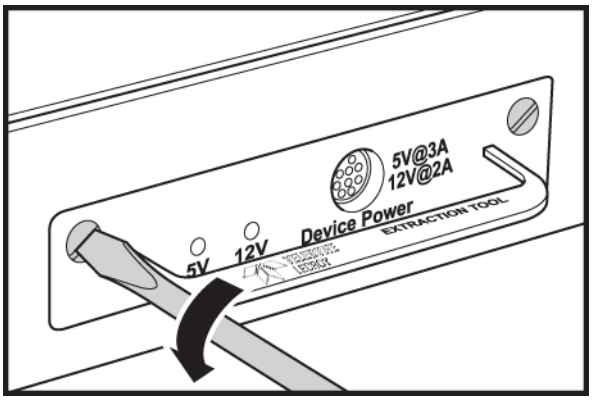
Note: If the prongs do not slip easily into the holes, use a small nail file or similar device to remove paint from the prongs.



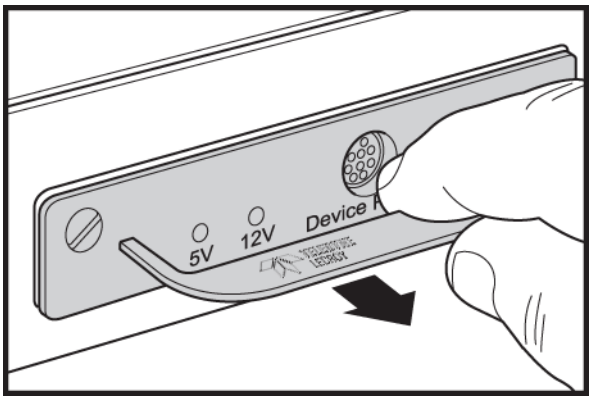
3. Rotate the extraction tool to a horizontal position to lock the prongs into place and make a handle.



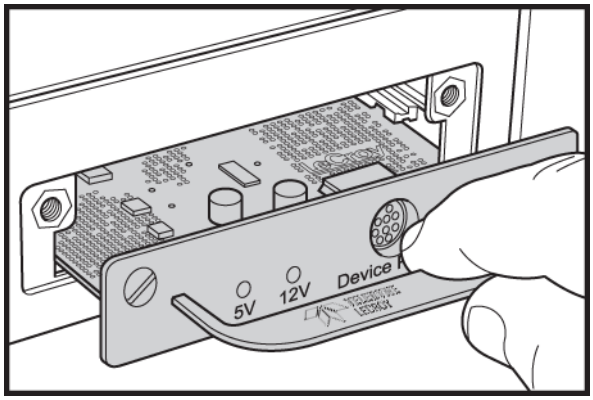
4. Using the screwdriver, loosen both retaining screws by rotating them counter-clockwise approximately two full turns, until feeling slight resistance. **Do not force the retaining screws** after two turns.



5. Using the extraction tool as a handle, gently wriggle the expansion card forward about 1⁄8”.



6. Repeat steps 4 and 5 approximately three times, until the card is free from the retaining screws and you can remove the card from the system.



1.10 Connecting via Ethernet

The Ethernet connection can have any of these configurations:

1. Analyzer connected to a network using a hub or switch, Gigabit Ethernet interface, or similar device.
2. Analyzer connected to the host machine (machine running the application software), using a hub or switch, Gigabit Ethernet interface, or similar device.
3. Analyzer connected directly to the host machine using a SATA cable.

1.11 Connecting to a Network

When connected to a network, the analyzer can communicate with the DHCP server to obtain IP address configuration information in order to establish a connection. Refer to “Select Device” on page 25.

1.12 Connecting over Different Subnets

If the host machine (with the Sierra software) and Sierra M6-2 are on the same subnet, they will see each other's broadcasts, and the Sierra M6-2 application will automatically appear in the Select Device dialog, from which you can select a device (as described in the previous section).

If the host machine and Sierra M6-2 do not reside on the same subnet, they will not see each other automatically. You must add the Sierra M6-2 IP address manually. To add the IP address, use the **Add Device** button (see Figure 1.15 on page 28).

1.13 TCP and UDP Ports Must Be Open to Connect over Ethernet

WARNING: Check your firewall settings before making Ethernet connections. Incorrect firewall settings can prevent Teledyne LeCroy applications from detecting analyzers on the network, though Ping works correctly. Consult your Firewall documentation to allow Teledyne LeCroy applications access to the network.

The following TCP and UDP ports must be open to connect over the Ethernet:

- **TCP Port**: 4000 to 4003
- **UDP Ports**: 4015 to 4017

1.14 Launching Your Analyzer

To launch the software, double-click the **SAS** or **SATA** Icon in the Program Manager Window.

1.15 Operating in Simulation Mode

The SAS/SATA applications operate in Simulation Mode by default if the software detects no hardware.

The Analyzer software launches and displays the appropriate tool bar, but with the limitation that the Analyzer operates only on static, previously captured, bus data.

Limitations Simulation Mode lets you try all of the available functions, but the system is not capturing any real data and is displaying only pre-captured results.

1.16 Using the Software

The Sierra M6-2 application has the Teledyne LeCroy SAS Protocol Suite and the Teledyne LeCroy SATA Protocol Suite.

The Teledyne LeCroy SAS Protocol Suite can be a:

- **Protocol Analyzer:** Captures data, triggers on events, and saves. **Easy Mode** allows standard Trigger and Data capture. **Advanced Mode** allows you to pro-

gram custom triggering in and out, capturing, state jumps, and timers (see “Protocol Analysis” on page 47).

- **Jammer:** The InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool that allows you to verify real-world fault handling (see “InFusion Overview” on page 327).
- **Protocol Analyzer Initiator Emulator:** Generates bus traffic for capture. It also has Easy Mode and Advanced Mode (see “Emulation” on page 119).
- **Target Emulator**: Acts as target (see “Target and Device Emulation” on page 172).

The Teledyne LeCroy SATA Protocol Suite can be a:

- **Protocol Analyzer:** Captures data, triggers on events, and saves. **Easy Mode** allows standard Trigger and Data capture. **Advanced Mode** allows you to program custom triggering in and out, capturing, state jumps, and timers (see “Protocol Analysis” on page 47).
- **Jammer:** The InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool that allows you to verify real-world fault handling (see “InFusion Overview” on page 327).
- **Protocol Analyzer Host Emulator:** Generates bus traffic for capture. It also has Easy Mode and Advanced Mode (see “Emulation” on page 119).
- **Device Emulator**: Acts as device (see “Target and Device Emulation” on page 172).

1.17 Getting Started with the Protocol Analyzer

To use the software for protocol analysis, first select **File > New > Protocol Analyzer** for a new project or **File > Open** an existing protocol analysis file: .**sac** for a SAS file or .**stc** for a SATA file (see “Protocol Analysis” on page 47). You can also open a **.scs** SAS Sample file or **.sts** SATA Sample file. Example files are in the Examples folder. You can also use **Project Setup > Last Protocol Analyzer.**

On the Capture tab, select to capture **Everything** or **Pattern**. For Pattern, select a Pattern. You can exclude patterns and frames. You can use different patterns for pre-trigger and post-trigger.

On the Trigger tab, select the trigger type. For Pattern, select the pattern.

On the Settings tab, select trigger position and memory use.

Change the Analyzer settings if necessary. Change the port Speed if necessary.

Use Advanced Mode only after you become familiar with the hardware and software and have special needs.

1.18 Protocol Analyzer Initiator Emulator or Host Emulator

To use the software for protocol analysis to generate host traffic, first select **File > New > Protocol Analyzer Initiator Emulation** or **Protocol Analyzer Host Emulation** for a new project or **File > Open** an existing Pattern Generator file: .**spg** for a single-role file (see “Emulation” on page 119).

In Easy Mode, on the Initiator Emulator or Host Emulator tab, insert instances of ATA, SCSI, TASK, SMP, Frame, or Event. Select the type of each from the drop-down lists. You can also loop, go to, wait, delay, if...then, and stop.

In Easy Mode, on the Capture tab, select to capture **Everything** or **Pattern**. For Pattern, select a Pattern. You can exclude patterns and frames. You can use different patterns for pre-trigger and post-trigger.

In Easy Mode, on the Trigger tab, select the trigger type. For Pattern, select the pattern.

In Easy Mode, on the Initiator Setting or Host Setting tab, select the port and speed. Select to run the Pattern Generator or Initiator Emulator or Host Emulator.

In Easy Mode, on the Settings tab, select trigger position and memory use. Also change the Analyzer settings if necessary. Specify addresses, stops, times, and sizes, if necessary.

Use Advanced Mode only after you become familiar with the hardware and software and have special needs.

1.19 Performance Analyzer

To do a Performance Analysis, select **File > New > Performance Analyzer.** Choose settings in the Performance Analysis dialog. Click Run Hardware (see “Performance Analysis” on page 167.)

1.20 Target Emulator or Device Emulator

To use the software as a target or device emulator, first select **File > New > Target Emulator** or **Device Emulator** for a new project or **File > Open** an existing Emulator file: **.std** Target Emulator file or **.sde** Device Emulator file (see “Target and Device Emulation” on page 172). You can also use **Project Setup > Last Target Emulator** or **Last Device Emulator.**

In the Pages tab, change settings for the supported pages if necessary.

In the Error Injection tab, select General periodic errors, Identify frames, Connection Management open and close connection errors, SAS Commands and events errors, ATA Commands errors, or SATA Signature content.

Use the User-defined Commands tab only after you have become familiar with operations.

In the Settings tab, select addresses, sizes, times, and ports, if necessary.

You can capture traffic when using an Analyzer project (but not a Target Emulator project). With a Protocol Analyzer open, open a **Target Emulator.** After checking the settings, click the **Activate/Deactivate** (Active) device button. or select **Project Setup > Active Device.** If you change Target Emulator settings, **Deactivate** and then **Activate Device**.

1.21 Teledyne LeCroy SAS and SATA Protocol Suite Menu Options and Toolbars

This section lists all the SAS and SATA Protocol Suite application menu options and the toolbars.

1.21.1 File

The File menu options allows you to perform common tasks such as open, close, save, export, print, send files and exit the application (see Figure 1.20).

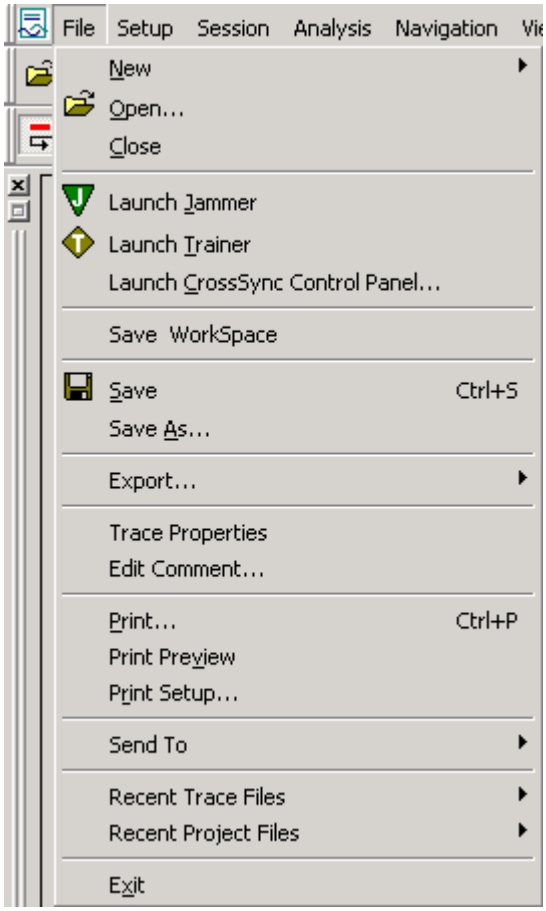


Figure 1.20: File Menu Option

1.21.2 Setup

For special work, you can use the Setup menu (see the following figure) to perform the following actions:

- Configure TxRxVout & Pre-emphasis (see “TxRx Vout & Preemphasis” on page 294)
- User Defined Decoding (see “User-Defined Decoding” on page 309)
- External Trig Setting (see “External Trig Setting” on page 306)
- Update Device (see “Update Device” on page 307)
- All Connected Devices (see “Select Device” on page 25)
- Find DUT (see “Find DUT” on page 320)
- Power Source Control (see “Power Source Control” on page 322)
- Manage Setup Licences (see “Floating License” on page 305)
- Set Preferences (see “Preferences” on page 296)
- Perform a Self Test (see “Self Test” on page 312)
- Create a Data Block (see “Data Blocks” on page 134)

- Set Port Alias (see “Set Port Alias” on page 292)
- Set SAS Address Alias (see “SAS Address Alias (SAS only)” on page 293)

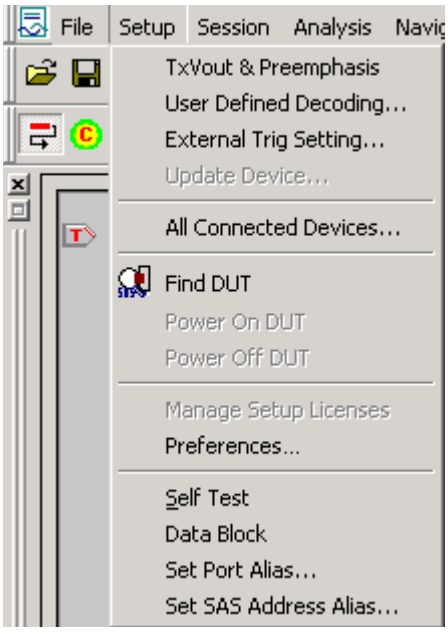


Figure 1.21: Setup Menu Option

1.21.3 Session

The Session menu has the following options:

- Start Capture/Record - Start capture or record a trace
- Pause Capture/Record - Aborts the capture without saving
- Stop Capture/Record - Stops the hardware
- Start Target Emulator - Starts the target emulator (SAS)
- Stop Target Emulator - Stops the target emulator (SAS)
- Start Device Emulator - Starts the device emulator (SATA)
- Stop Device Emulator - Stops the device emulator (SATA)

1.21.4 Analysis

The Analysis menu allows you to view captured data (see the following screen capture).

Menu items and toolbar options are enabled or disabled and displayed or hidden based on the type of window open. The following types of windows can be displayed:

- No active window
- Project file open
- Trace file open

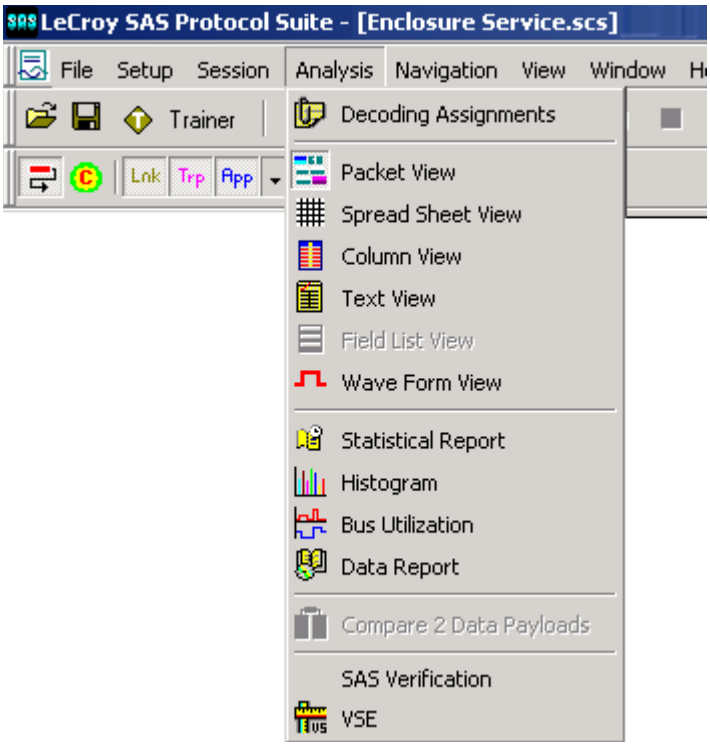


Figure 1.22: SAS Analysis Menu

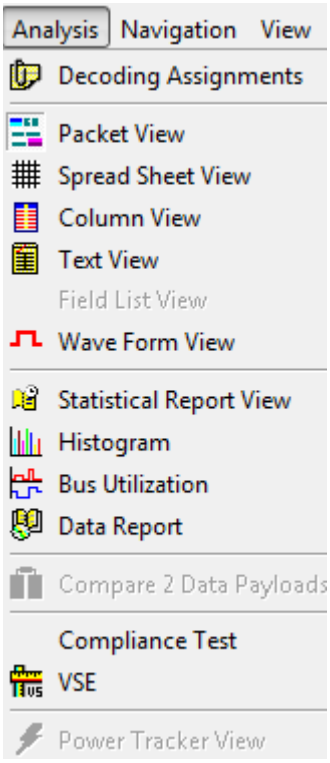


Figure 1.23: SATA Analysis Menu

1.21.5 Viewing Captured Data

Captured data can be displayed in several views. Select **Analysis** from the drop-down menu to access the different views (see "Analysis" on page 208). You can display the same data in:

- **Packet View**: Displays packets
- **Spreadsheet View**: Displays Packet View fields by time
- **Column View**: Shows DWORDs in columns by port
- **Text View**: Shows transaction frames, grouped in columns by port
- **Frame Inspector View:** Has lots of information that is available in Packet View, but not Spreadsheet View, so it is most useful in conjunction with the Spreadsheet View.
- **Waveform Display**: Shows waveform display for all active ports, on which you can perform timing measurements
- **Statistical Report**: generate statistics for all transports, commands, primitives, bus conditions, addresses, lanes, and errors
- **Histogram View**: Shows frame-type transfers
- **Bus Utilization:** Displays the utilization of the bus
- **Data Reports**: Displays data payloads
- **Compare 2 Data Payloads:** Compares two data payloads
- **SAS Verification**: Verifies compliance with the SAS specification
- **Compliance Test**: Verifies compliance with the SATA specification
- **VSE**: Perform custom post-process analysis of the open trace by running a verification script over the trace
- **Power Tracker View**: Displays power statistics

1.21.6 Navigation

The Navigation menu has the following options to navigate through the application (see the following screen capture).

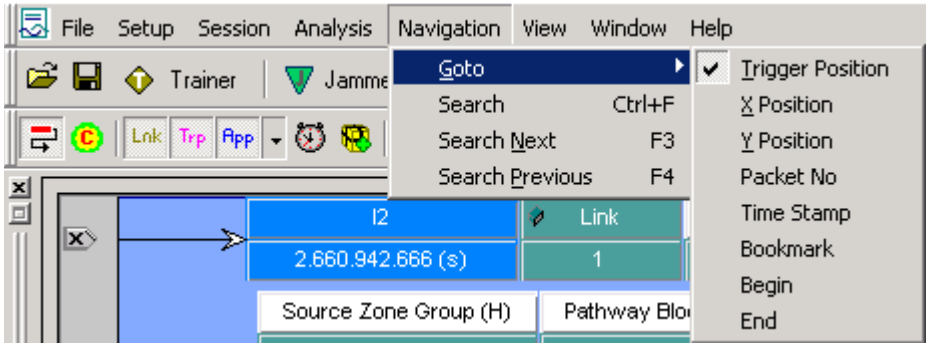


Figure 1.24: Navigation Menu Option

- Goto
  - Trigger Position
  - X Position
  - Y Position
  - Packet No

- Time Stamp
- Bookmark
- Begin
- End

- Search
- Search Next
- Search Previous

1.21.7 View

The View menu options allows the user to zoom in and out, enable/disable filtering and toolbars among other actions. It has the following options.

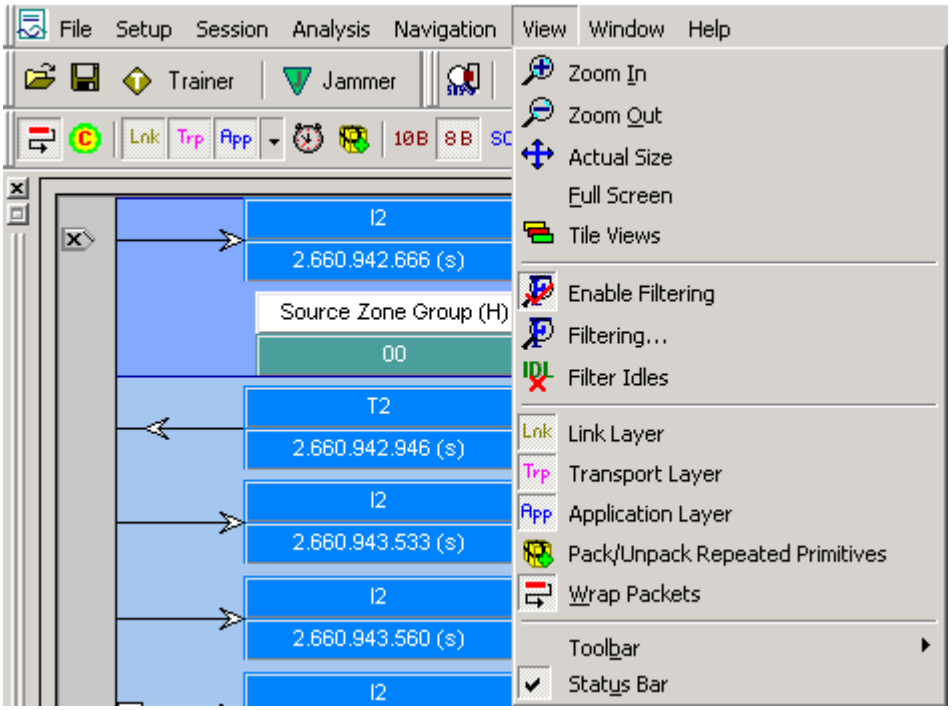


Figure 1.25: View Menu Option

- Zoom In (refer to “Navigation + View Toolbar” on page 256)
- Zoom Out (refer to “Navigation + View Toolbar” on page 256)
- Actual Size (refer to “Navigation + View Toolbar” on page 256)
- Tile Views (refer to “Navigation + View Toolbar” on page 256))
- Enable Filtering (refer to “Filter Setup” on page 261)
- Filtering (refer to “Filter Setup” on page 261)
- Filter Idles (refer to “Filter Setup” on page 261)
- Link Layer-SAS only (refer to “Packet View Toolbar” on page 276)
- Transport Layer-SAS only (refer to “Packet View Toolbar” on page 276)
- Application Layer-SAS only (refer to “Packet View Toolbar” on page 276)
- Pack/Unpack Repeated Primitives-SAS only (refer to “Packet View Toolbar” on page 276)
- Physical Layer-SATA only (refer to “Packet View Toolbar” on page 276)
- FIS Layer-SATA only (refer to “Packet View Toolbar” on page 276)

- Command Layer-SATA only (refer to “Packet View Toolbar” on page 276)
- Wrap Packets (refer to (refer to “Packet View Toolbar” on page 276)
- Tool bar (allows you to customize the toolbar with the options given below)
  - Main
  - Record+Capture
  - Analysis
  - Navigation+View
  - Column View
  - Cursor position
  - Target Emulator
- Status Bar (refer to “Cursor Position Status Bar” on page 286)

1.21.8 Window

The Window menu has the following options:

- **Cascade:** Displays all open windows in an overlapping arrangement.
- **Tile Horizontal:** Displays all open windows in a above-below arrangement.
- **Tile Vertical:** Displays all open windows in a side-by-side arrangement.
- **Arrange Icons:** Arranges minimized windows at the bottom of the display.
- **Close All:** Closes all windows.

1.21.9 Help

For more information see “Help Menu” on page 309.

1.21.10 Toolbars

The toolbars enable you to perform several actions, some of which are listed below.

- Show or hide fields and ports, change port names, and change data format.
- Show the layers and channels using their toolbars.
- Decode using the Decode toolbar.
- Search and Filter.

There are six sets of toolbars (see the following screen capture):

- Main Toolbar - For details on the Main Toolbar refer to “SAS Main Toolbar” on page 50 and “SATA Main Toolbar” on page 51.
- Record Capture Toolbar - For additional information see “SAS Main Toolbar” on page 50 and “SATA Main Toolbar” on page 51.
- Target/Device Emulator Toolbar - For additional information see “SAS Main Toolbar” on page 50 and “SATA Main Toolbar” on page 51.
- Navigation + View Toolbar - For additional information see “Navigation + View Toolbar” on page 256.
- Show Analysis Toolbar - For additional information see “Show Analysis Toolbar” on page 208.
- Packets View Toolbar - For additional information see “Packet View Toolbar” on page 276.

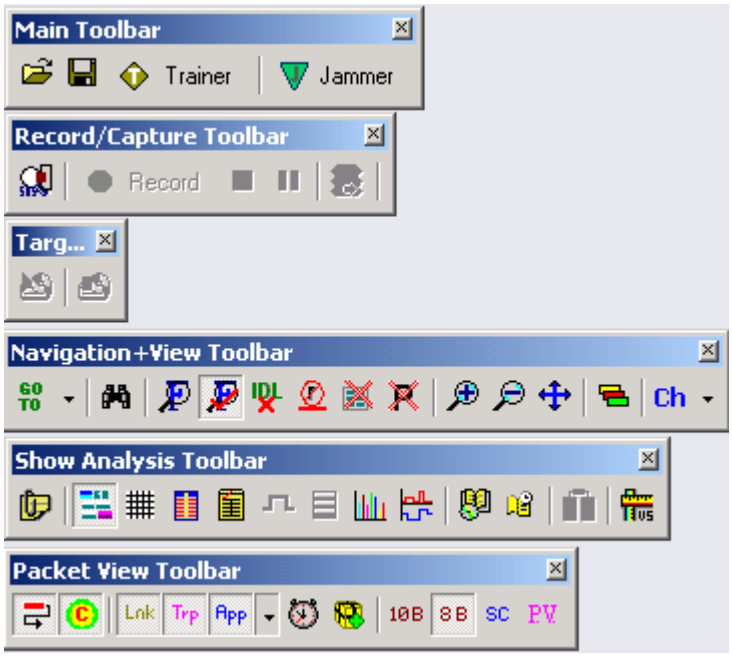


Figure 1.26: SAS/SATA Protocol Suite Toolbars

1.22 Port Status

You can display an overview of the active ports by clicking the buttons at the bottom right of the main window (see “Port Status” on page 284).

1.23 InFusion

The Teledyne LeCroy InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool for traffic passing through the Jammer. It allows you to verify real-world fault handling for Serial Attached SCSI (SAS) and Serial ATA (SATA) systems.

Click on the Jammer icon

to invoke the Teledyne LeCroy SAS or SATA InFusion, see “InFusion Overview” on page 327.

You can toggle between the InFusion and Analyzer panes by using the Alt+Tab keys, the Windows Task Bar or by pressing the respective toolbar button in each pane.

1.24 Trainer

The SAS *Trainer* is a traffic generator that can emulate a SAS initiator/target or SATA host/device. Traffic generation enables engineers to test designs under realistic conditions and to transmit known errors, allowing engineers to observe how devices handle faulty link conditions.

Traffic generation is performed via the execution of text-based scripts. These traffic generation files (*.**ssg**) contain statements about the types of traffic to be generated. These script files can be edited with either a simple text editor such as Notepad or with the included Script Editor utility.

Click on the Trainer icon

to invoke the Teledyne LeCroy SAS or SATA Trainer, see “Sierra Trainer Traffic Generation” on page 387.

You can toggle between the Trainer and Analyzer panes by using the Alt+Tab keys, the Windows Task Bar or by pressing the respective toolbar button in each pane.

Chapter 2

Protocol Analysis

A default analyzer project is created automatically when the application starts. An analyzer project contains all the settings for capturing, triggering and memory usage. A project can be saved as a ***.sac** files for later use.

2.1 Easy Mode (Pre-Defined Setups)

After you install the Analyzer software (see “Software Installation” on page 20) and set up the Analyzer (see “Hardware Setup” on page 21), launch the Analyzer software (see “Launching Your Analyzer” on page 35) to display the default Protocol Analyzer in Easy Mode at the Capture tab.

The default Protocol Analyzer uses the Easy Mode which allows triggering and data capture. The Easy Mode also supports the SAS Initiator Emulator and SATA Host Emulator modes to generate bus traffic.

2.2 Main Window

Use Easy Mode to get a comprehensive overview of your analyzer’s capabilities. Use the default Analyzer Project or create a new project.

For **SAS**: on the Analyzer Menu Bar, click **File > New > Protocol Analyzer** to open a SAS Protocol Analyzer dialog.

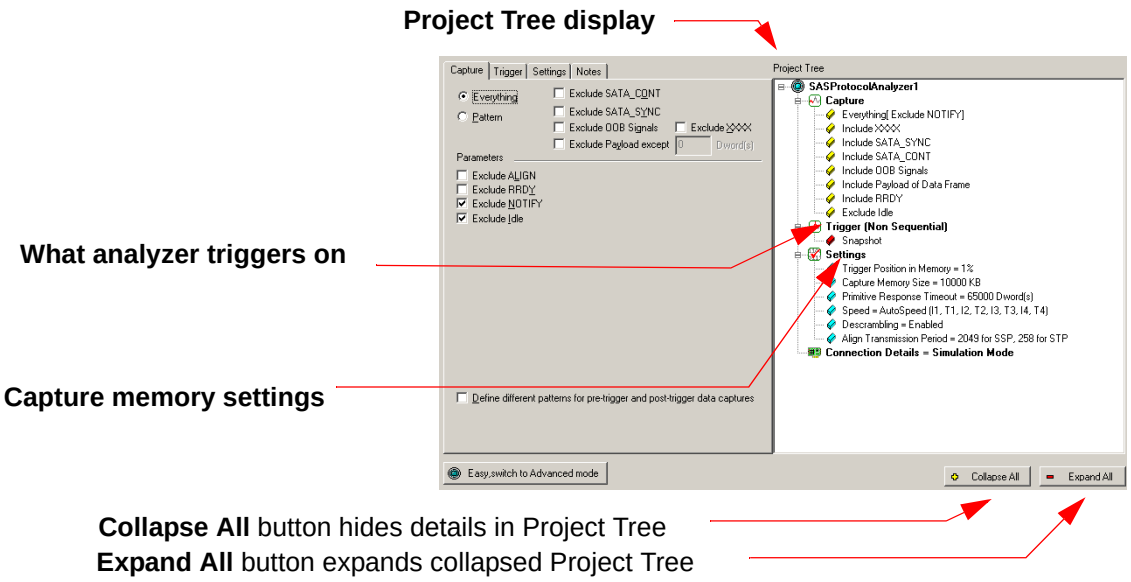


Figure 2.1: SAS: New Analysis Project Dialog

The New Project dialog opens with default settings to capture Everything on the bus and to Trigger On on Snapshot. (The analyzer captures everything immediately without triggering on anything in particular.)

SATA: On the Analyzer Menu Bar, click **File > New > Protocol Analyzer** to open a SATA Protocol Analyzer dialog.

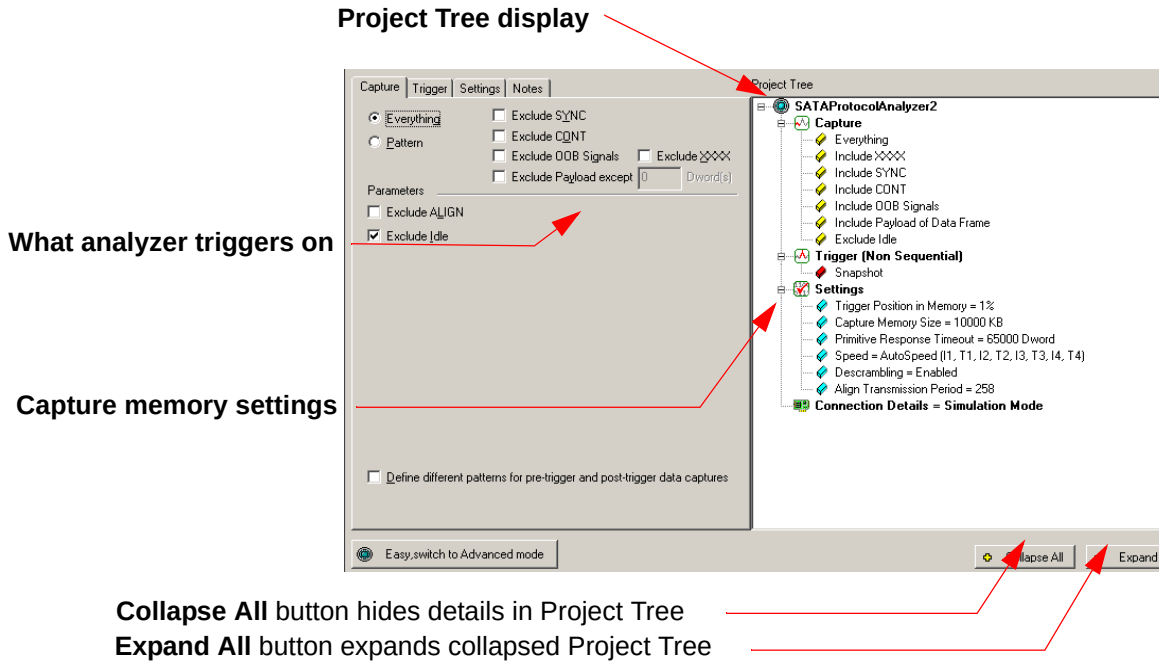


Figure 2.2: SATA: New Analysis Project Dialog

SAS vs. SATA: SATA Dialog does not show “Exclude RRDY” or “Exclude NOTIFY”. SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”.

2.3 Project Tree

The Project Tree on the right side of the main window displays a comprehensive tree structured overview of the project. The project tree shows the capture configuration, trigger setups, and the capture memory settings.

2.3.1 Capture Tab Fields

The Capture tab has the following fields:

Exclude SATA_CONT (SAS) or Exclude CONT (SATA)

Check this to exclude SATA_CONT primitives from the data capture.

Exclude SATA_SYNC (SAS) or Exclude SYNC (SATA)

Check this to exclude SATA_SYNC primitives from the data capture.

Exclude OOB Signals

Check this to exclude OOB signals from the data capture.

Exclude XXXX

Check this to exclude XXXX patterns from the data capture.

Note: The validity of time stamps during Idles is traded off against good buffer memory utilization when using ‘Exclude XXXX’.

Exclude Dev Slp Packets (SATA)

Check this to exclude Dev Slp Packets from the data capture.

Exclude Payload except

Check this to exclude Payload of Data Frames from the data capture. You can except a number of DWORD(s).

Note: The Data Report (refer to “Data Report” on page 243) does not reflect excluded Payload of Data Frames.

Note: When showing truncated data in the Data Payload View, the truncation points are marked with a separator placed between payloads. You can get more information about the data exclusion using the tooltip over the separator.

Exclude ALIGN

Check this to exclude ALIGN primitives from the data capture.

Exclude RRDY (SAS only)

Check this to exclude RRDY primitives from the data capture.

Exclude NOTIFY (SAS only)

Check this to exclude NOTIFY primitives from the data capture.

Exclude Idle

Check this to exclude Idles from the data capture.

Define different patterns for pre-trigger and post-trigger data captures

Replaces the Capture tab with a Pre-Trigger Capture tab and a Post-Trigger Capture tab.

2.4 SAS/SATA Software Menus and Toolbars

The SAS and SATA software has the following menus and toolbars.

2.4.1 SAS Main Toolbar

The following figure displays the SAS main toolbar.

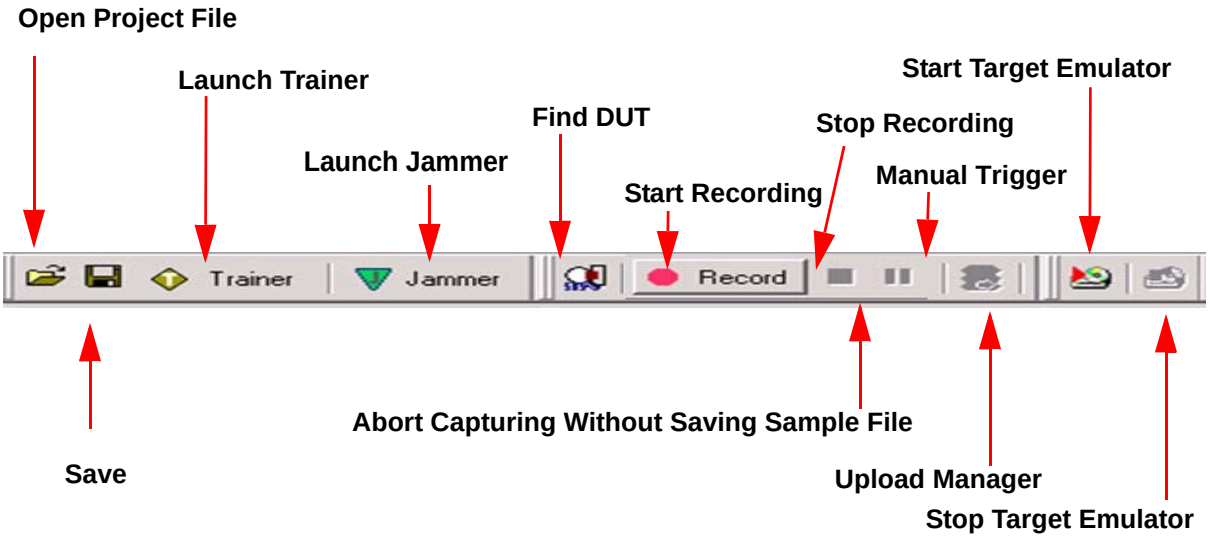


Figure 2.3: SAS: Software Menus and Toolbar

2.4.2 SATA Main Toolbar

The following figure displays the SATA main toolbar.

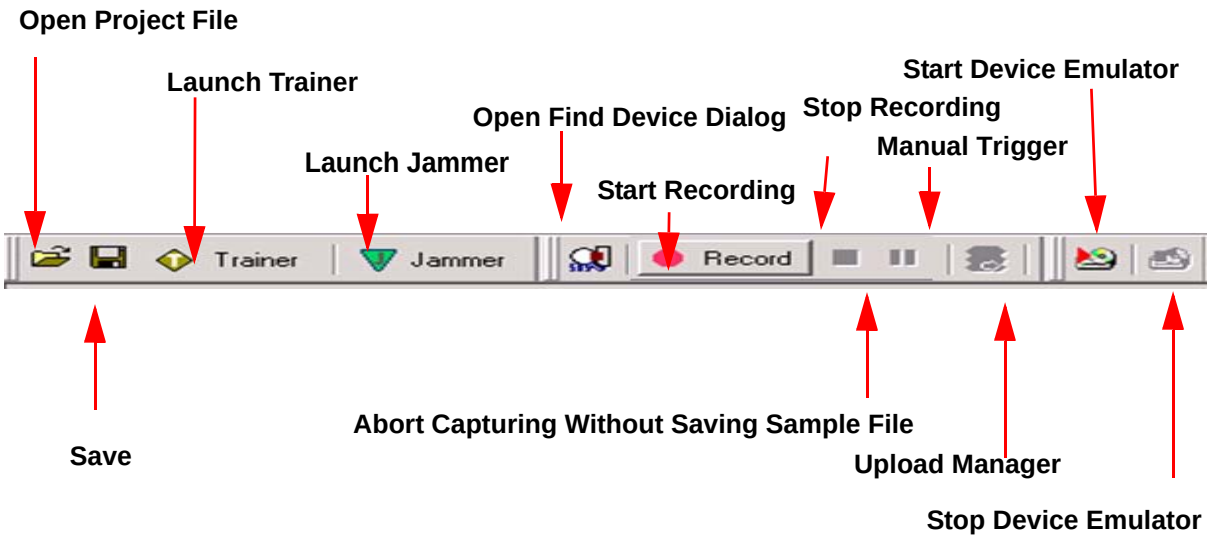


Figure 2.4: SATA: Software Menus and Toolbar

2.5 Start Recording

To get an immediate overview of the bus traffic to and from your Analyzer:

1. Click the

Record button.
2. The analyzer begins filling the defined memory buffer with traffic captured from the bus. After the traffic fills the memory buffer, the traffic is uploaded to the viewer and the Packet View display opens. Packet View is the default display. However, more views are available by selecting **View** on the menu bar and choosing the desired View.

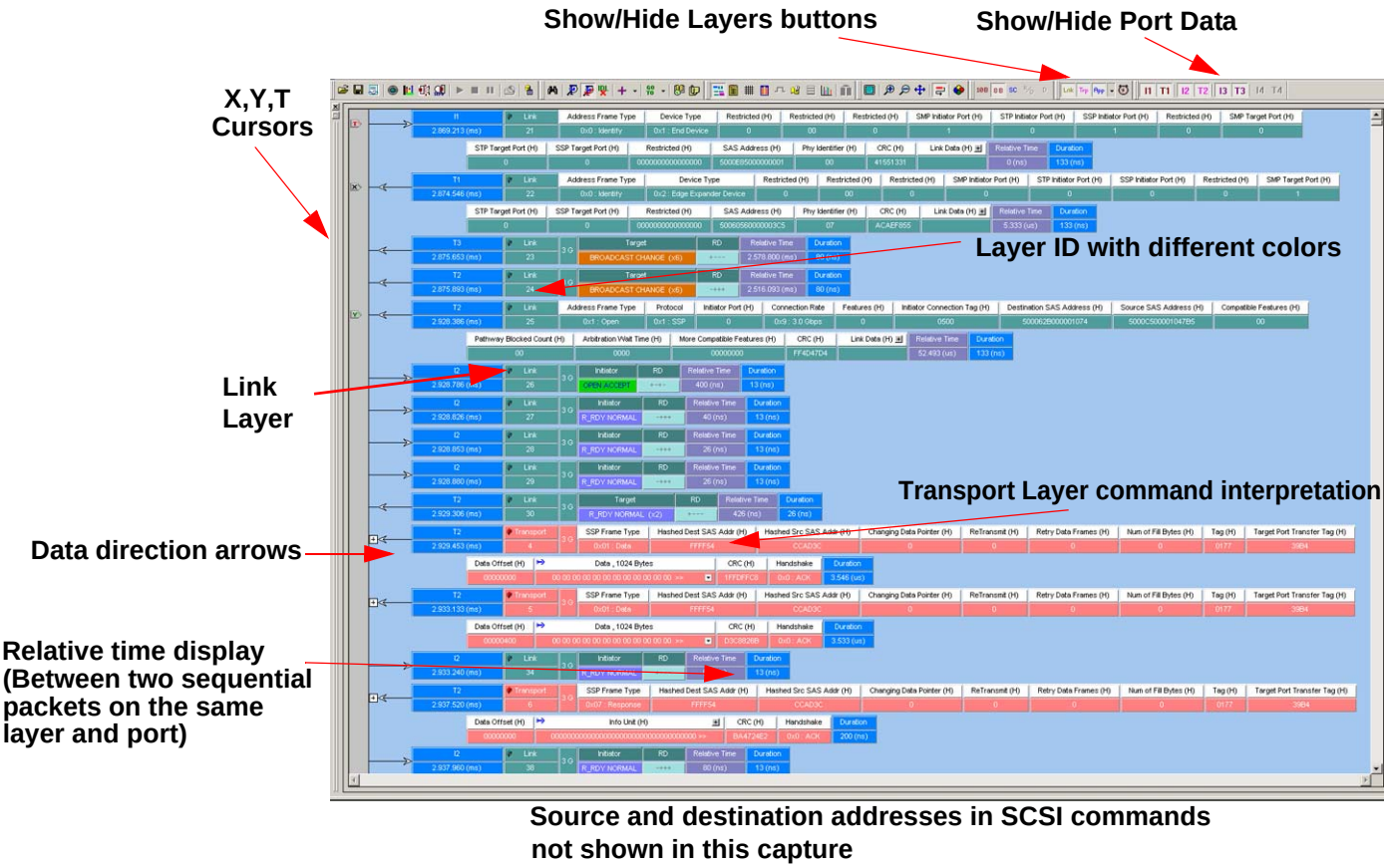

Show/Hide Layers buttons
Show/Hide Port Data
X,Y,T Cursors
Layer ID with different colors
Link Layer
Transport Layer command interpretation
Data direction arrows
Relative time display (Between two sequential packets on the same layer and port)
Source and destination addresses in SCSI commands not shown in this capture

Figure 2.5: SAS: Typical Packet View

Note: When using the Advanced Mode sequencer, the analyzer logs the state transitions in the trace, with the name the user gives to the state.

In the Packet View, right-click on any packet and select **Show->State**, to display the states and their transitions in the trace.

SAS: In case of an STP interface, the expander displays STP addresses provided to the SATA drive and the SAS software integrates the STP addresses in the ATA command.

The results display shows each transaction for every layer identified in a different color and the data direction identified with data direction arrows. Upstream traffic has an arrow from right to left: ⇐. Downstream traffic has an arrow left to right: ⇒.

Layers can be hidden by clicking the corresponding **Show/Hide** button on the menu bar. The system retains all captured data, but the display has fewer data layers for simpler viewing.

You can configure the viewer display for test and viewing preferences (see “Viewer Display” on page 205 for details about configuring the viewer display).

The Analysis Project dialog offers you a comprehensive set of choices to create a trigger and capture project satisfying some specific need. You can set the Analyzer to:

- Capture specific patterns (see "Patterns and Data Capture Setup" on page 63).
- Capture different patterns pre- and post-trigger.
- Exclude parameters from capture.
- Trigger on a pattern or sequence of patterns (see "Trigger Setup" on page 78).
- Configure trace capture memory (Settings tab).
- Select file to save trace capture in memory (Settings tab).
- Include a project note (Notes tab).

2.5.1 Launch Jammer

The Launch Jammer option invokes InFusion. For more information refer to “InFusion Overview” on page 327

2.5.2 Launch Trainer

The Launch Trainer option invokes Trainer. For more information refer to “Sierra Trainer Traffic Generation” on page 387.

2.5.3 CrossSync Control Panel

The CrossSync Control Panel allows you to select analyzers for synchronization and manage the recording process. It supports a wide combination of Teledyne LeCroy’s flagship analyzers including PCI Express Gen 1, Gen 2 and Gen 3; USB 2.0 and 3.0; Serial ATA (SATA) 1.5, 3 and 6Gbps; Serial Attached SCSI (SAS) 6Gbps and Fibre Channel 1. 2, 4 and 8Gbps systems.

CrossSync is Teledyne LeCroy’s analyzer synchronization solution that enables time-aligned display of protocol traffic from multiple daisy-chained analyzers showing packet traffic from multiple high-speed serial busses. A lightweight software control panel allows users to select analyzers for synchronization and manage the recording process. Captured traffic is displayed using the latest analyzer software (in separate windows) with all the protocol specific search and reporting features.

Captured packets are displayed in separate windows that share a common time scale. Navigating the traffic in either direction will scroll to the same timestamp in a synchronized window. When using the CrossSync option, users can access the full complement of analysis capabilities available within the individual Teledyne LeCroy software. Search, reporting, and decoding all operate normally.

This feature is available with the Teledyne LeCroy SAS/SATA Protocol Suite application.

Launching the CrossSync Control Panel

To launch CrossSync from the SAS/SATA Protocol Suite software application, click on **File** and select **Launch CrossSync Control Panel** (see the screens below). Or, you can launch CrossSync from the ‘**Start**’ menu.

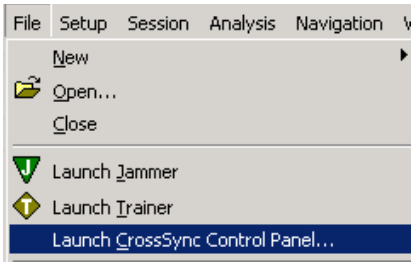


Figure 2.6: Launching CrossSync from the SAS Protocol Suite Application

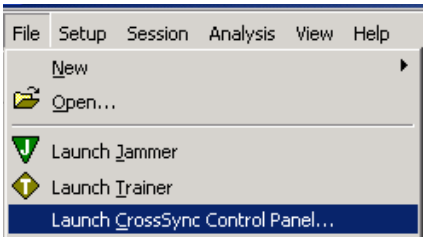


Figure 2.7: Launching CrossSync from the SATA Protocol Suite Application

Please refer to the ***CrossSync Control Panel User Manual*** for more information.

2.5.4 Save Workspace

Viewing parameters can be saved in a workspace as a **.wss** file.

After you open a trace and select views, you can save the viewing parameters in a workspace file. Select **File > Save Workspace** to open a Save As dialog. Save the current workspace as a **.wss** file.

To set a default workspace viewing parameters, select **Setup > Preferences** and select the Trace Viewer tab. In the Default Workspace field, enter the path and name of a saved workspace **.wss** file.

The workspace can be switched after opening a trace file. Select **File > Open** to open another workspace and select a **.wss** file.

2.5.5 Saving a Trace Capture

You can save a Trace Capture by selecting **Save** from the **File** menu, or select **Save As** to save as the trace capture for review at a later time using the following dialog.

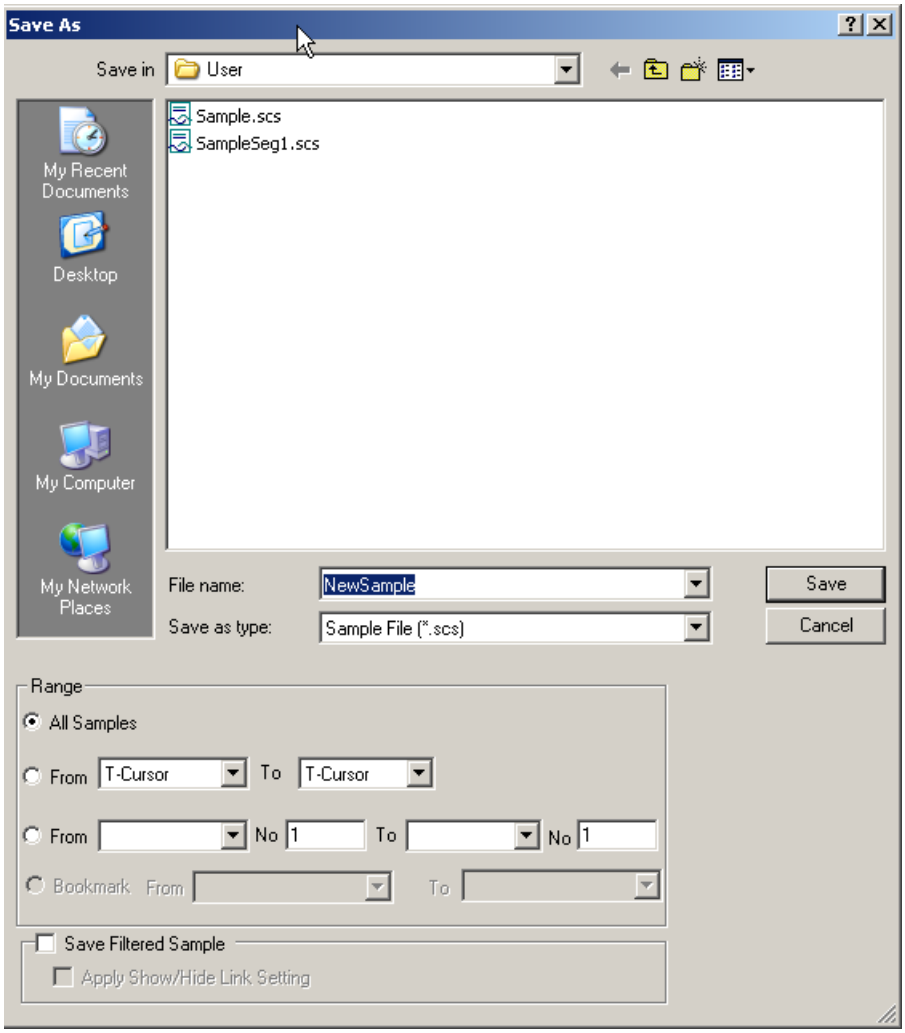


Figure 2.8: Save As Dialog

You can limit the range of the saved file. You can save:

- All Samples
- Range between selected cursors
- Range between selected Idle, link, commands
- Range between bookmarks

The **Save Filtered Sample** checkbox saves a trace file without filtered data. The **Apply Show/Hide Link Setting** checkbox filters the saved data further by also applying the current status of the port buttons of the toolbar.

2.5.6 Exporting

From the File menu, you can Export to Text/Excel, Export to Initiator Emulator, Export to Trainer, Export Read-Write Command Report, or Export Paired SAS Address Report.

Export to Text/Excel

From the File menu, you can export to Text/Excel, using the **Export to Text/Excel.** The **Save as Text** dialog displays.

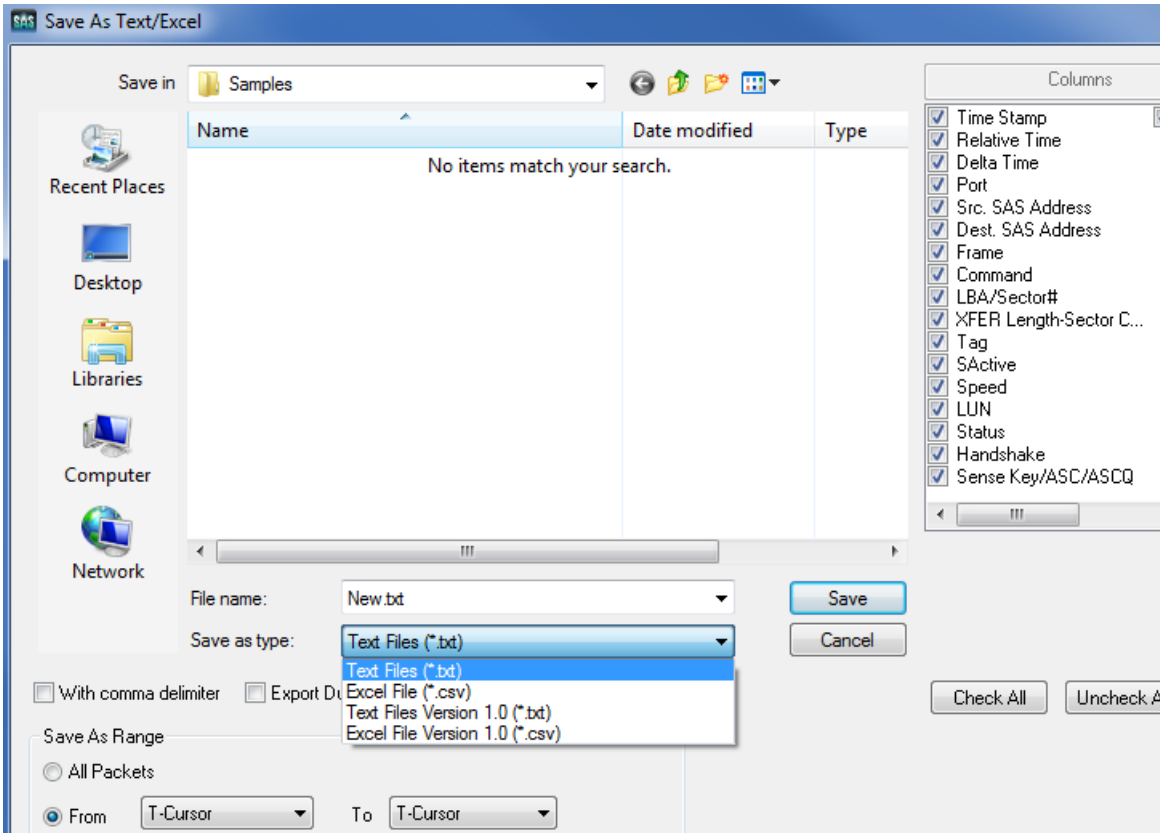


Figure 2.9: Save As Text Dialog

- From the Save as type: drop-down select Text Files.txt or Text Files Version 1.0 .txt for text format or Excel File.csv or Excel Files Version 1.0.csv for Excel format (see “Save As Display Formats” on page 56).
- Check the box **Export the whole payload (more than 32KB)** to export the whole payload (more than 32KB).
- You can limit the range of the saved file. You can save:
  - All Packets
  - Range between selected cursors
- Range between bookmarks

Save As Display Formats

The following figure describes the four different Save As type formats:

XFER Length-Sector Count
2048 - 4

Excel File.csv format

XFER Length
2048

Excel Files Version 1.0.csv format

2048 - 4

Text Files.txt format

2048

Text Files Version 1.0.txt format

Export to Initiator Emulator (SAS) or Host Emulator (SATA)

From the File menu, you can Export to Initiator Emulator (SAS) or Export to Host Emulator (SATA), using the Extract Sample File dialog (see following figures).

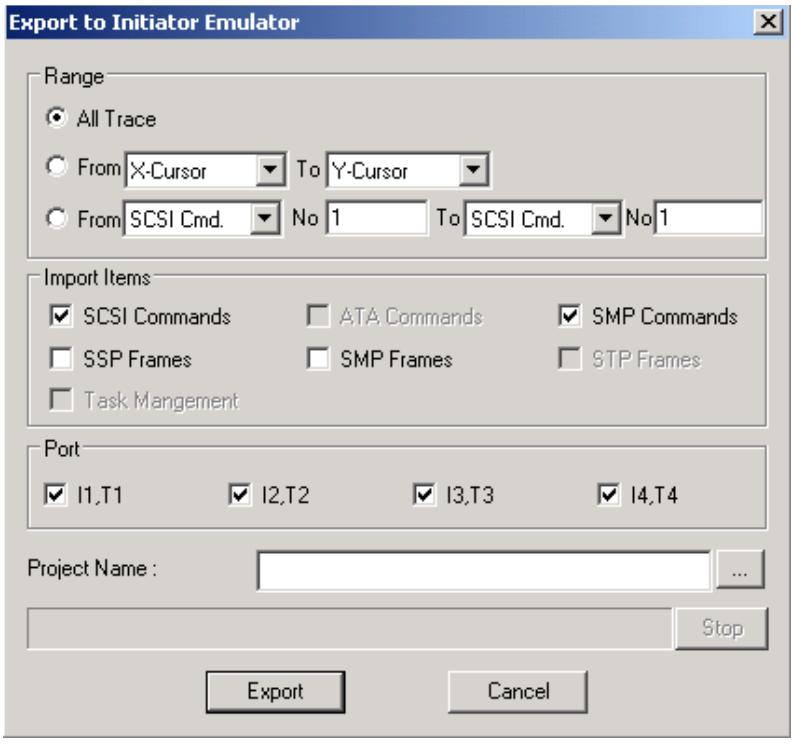


Figure 2.10: Export to Initiator Emulator (SAS) Dialog

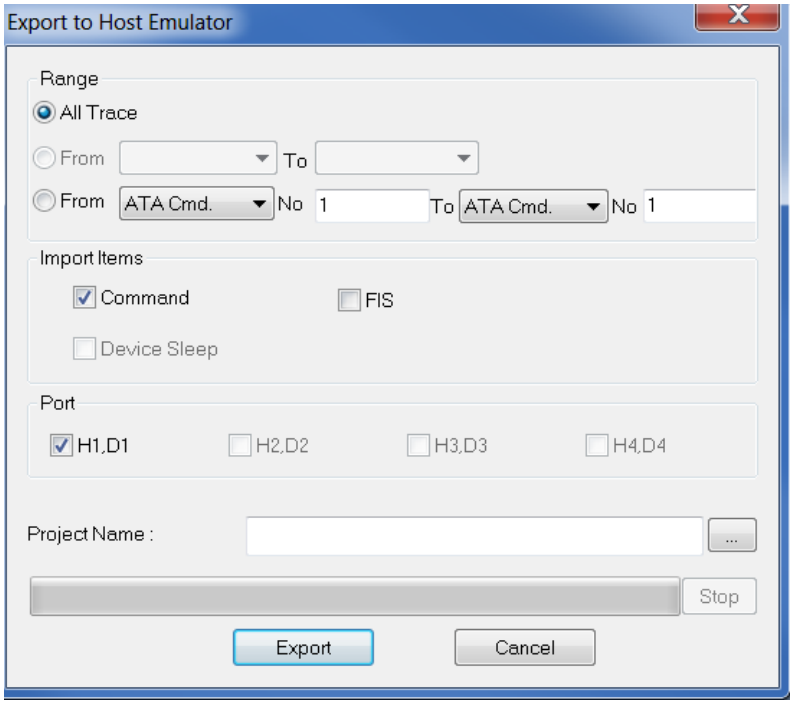


Figure 2.11: Export to Host Emulator (SATA) Dialog

You can limit the range of the saved file. You can save:

- All Trace
- Range between selected cursors
- Range between SCSI Commands or Transport

You can import **SCSI Commands, Task Management, ATA Commands, SSP Frames, SMP Frames, SMP Commands**, or **STP Frames**.

You can select the **Port**.

In the **Project Name**, enter a valid file name.

Export to Trainer

The Export to Trainer dialog, accessible from the File menu, allows exporting data to a file in a format supported by the timer.

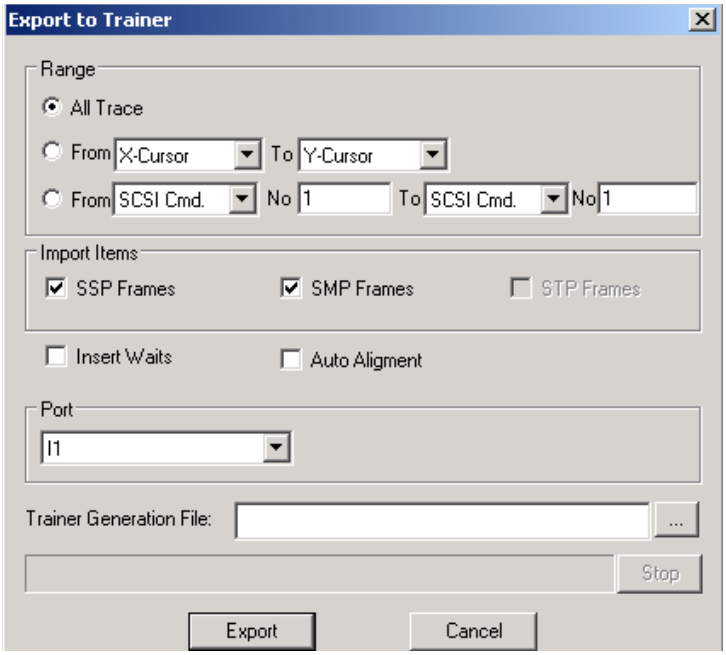


Figure 2.12: Export to Trainer (SAS) Dialog

In the Export to Trainer dialog you can

- Limit the range of the saved file. You can save:
  - All Traces
  - Range between selected cursors
  - Range between SCSI Commands or Transport
- You can import **SSP Frames, SMP Frames,** or **STP Frames** (see “Events and Event Properties” on page 453).
- You can **Insert Waits** (see “Wait Commands” on page 428).
- You can use **Auto Alignment** (see “The Global Setting “AutoAlign”” on page 399).
- You can select the **Port** (see “Setup Menu” on page 388).
- Indicate **Trainer Generation File Name** and click **Export** to export the trainer generation file.

Note: The resulting Trainer Generation file cannot exceed 2 MB or 1,000,000 packets.

Export Read/Write Command Report

From the File menu, you can Export Read/Write Command Report as an Excel file, using the Save As dialog.

2.5.7 Export Paired SAS Address Report

If Text View is activated, from the File menu you can save a Paired SAS Address Report as an Excel file, using the Export Paired SAS Address Report dialog.

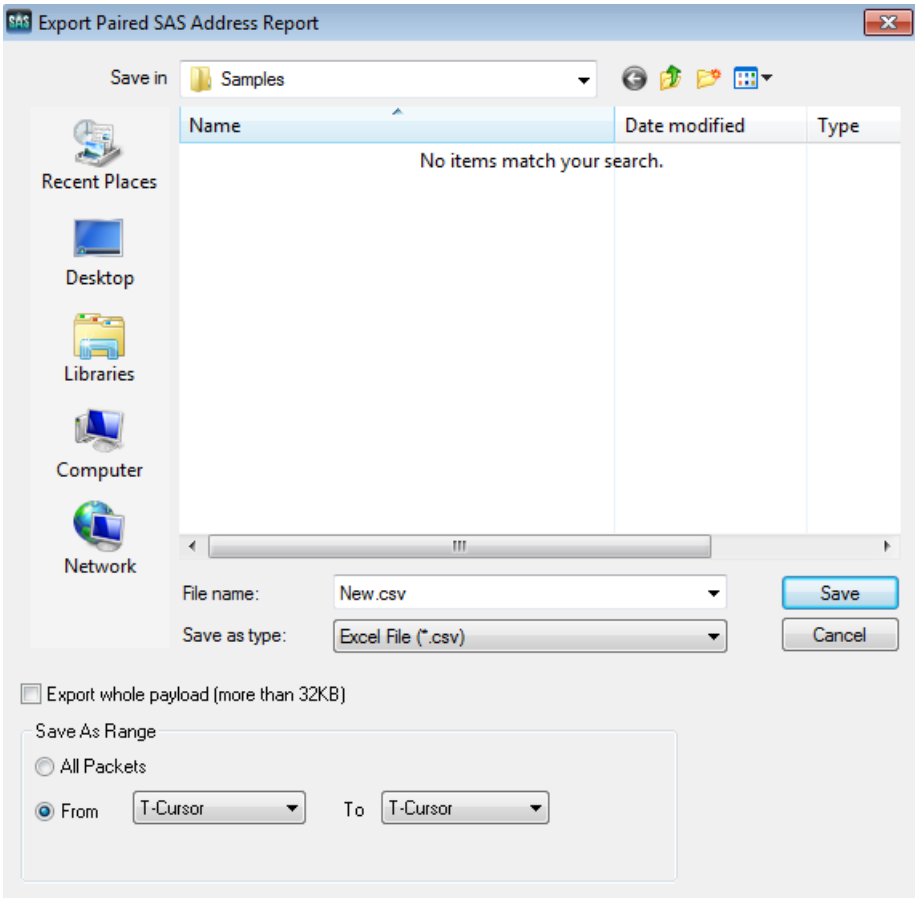


Figure 2.13: Export Paired SAS Address Report Dialog

- Check the box **Export the whole payload (more than 32KB)** to export the whole payload (more than 32KB).
- You can limit the data range of the saved file. You can save:
  - All Packets
  - Range between selected cursors

You can view expanded traffic (particularly during discovery) in a spreadsheet format. You can use column headers with SAS Address Pairs. For example, instead of I1, T1, I2, T2, and so on, the columns are Source/Destination SAS Address pairs, such as S1:SEP or S2:EXP 0.

2.5.8 Trace Properties

Select **File > Trace Properties** to see the properties of the trace. For more information refer to “Trace Properties” on page 207.

2.5.9 Edit Comment

You can write comments and edit them for a trace for future use. Select **File > Edit Comment** to view the edit window. Key in the comments and close the window.

2.6 Projects

You can define a new project, starting with the default project definition, or modify the settings for the last project run.

New Default Project

To start a New project, select **File > New** on the main menu bar and choose Protocol Analyzer to open a new project with default settings that you can modify (see “Main Window” on page 47).

Last Project

Clicking the Green button opens the last project run, so you can modify it.

2.6.1 Project File Types

Projects have the following file types:

*.asl	Decoding script file (in the Examples folder “User Define Decoding Script” subfolder)
*.cfg	Display Configuration file (in the System folder “Config” subfolder)
*.dat	DataBlock file (in the System folder “DataBlock” subfolder)
*.sac	SAS Protocol Analyzer/Capture Project/Viewer file (in the Examples folder “EasyCaptr”, “AdvanceCaptr”, or “Exerciser” subfolders)
*.saf	Device Identifier file
*.scs	SAS Sample file (in the SAS Examples folder “Sample” subfolder)
*.sde	Device Emulator file (in the System folder “Compliance” subfolder)
*.sfl	Filter configuration file
*.spg	Single-role Pattern Generator file (in the Examples folder SAS “PatternGenerator\Single role (spg files)” subfolder and SATA “PatternGenerator\Single Role” subfolder). Single role means the file is for a Device or Host.
*.ssh	SAS Search configuration File

*.stc	SATA Protocol Analyzer/Capture Project/Viewer file (in the Examples folder “EasyCaptr”, “AdvanceCaptr”, or “Exerciser” subfolders)
*.std	Target Emulator file (in the Examples folder “Target Emulator” subfolder)
*.sts	SATA Sample file (in the SATA Examples folder “Sample” subfolder)
*.tsh	SATA Search configuration file
*.wss	SAS Workspace file (in the SAS System folder “Predefined\Workspace” subfolder)
*.wst	SATA Workspace file (in the SATA System folder “PreDefined\Workspace” subfolder)

2.6.2 Example Projects

The Analyzer includes example projects that you can use to perform an immediate analysis without any setup.

The Analyzer system software has a pre-defined folder (directory) structure for storing all files. All example files are in the Examples folder under the Sierra M6-2 folder.

It is strongly recommended that you open some example files to see types of projects that you can create.

2.6.3 Run an Example Analysis Project

To run an example project:

1. Select **File > Open**.
2. Locate example analysis projects by looking in the Examples folder. Examples are available for AdvanceCaptr, EasyCaptr, Exerciser, PatternGenerator, Samples, Target Emulator, and User Define Decoding Script.
3. In the EasyCaptr folder, choose an example ***.sac** file and click **Open** to display the example project dialog.

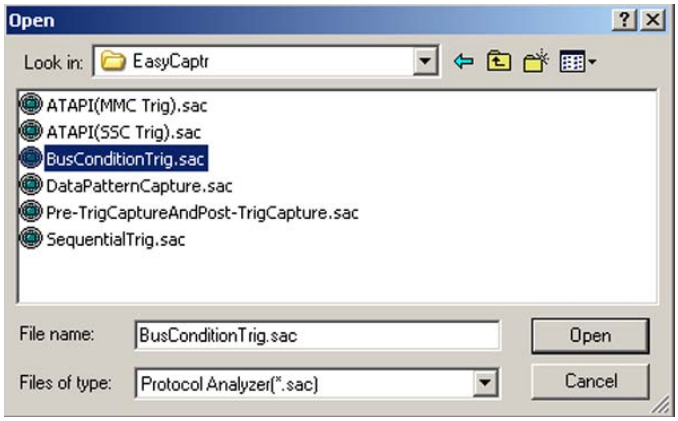


Figure 2.14: File Open Dialog

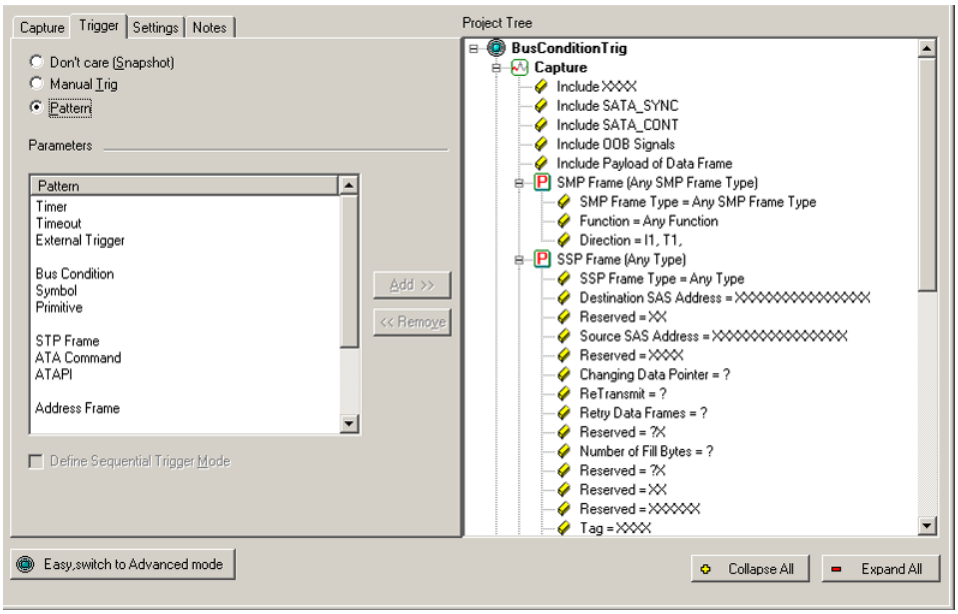


Figure 2.15: SAS: Sample Protocol Analysis Project

SAS vs. SATA: For Pattern Parameters, SATA Dialog adds FIS, FIS Pattern, and ATA Command Pattern and does not have STP Frame, SSP Frame, SMP Frame, and Address Frame.

4. Click the **Record** button to execute the pre-defined example.
5. After the project runs, you see an analyzer trace capture display similar to the one shown in (Figure 2.16 on page 63).

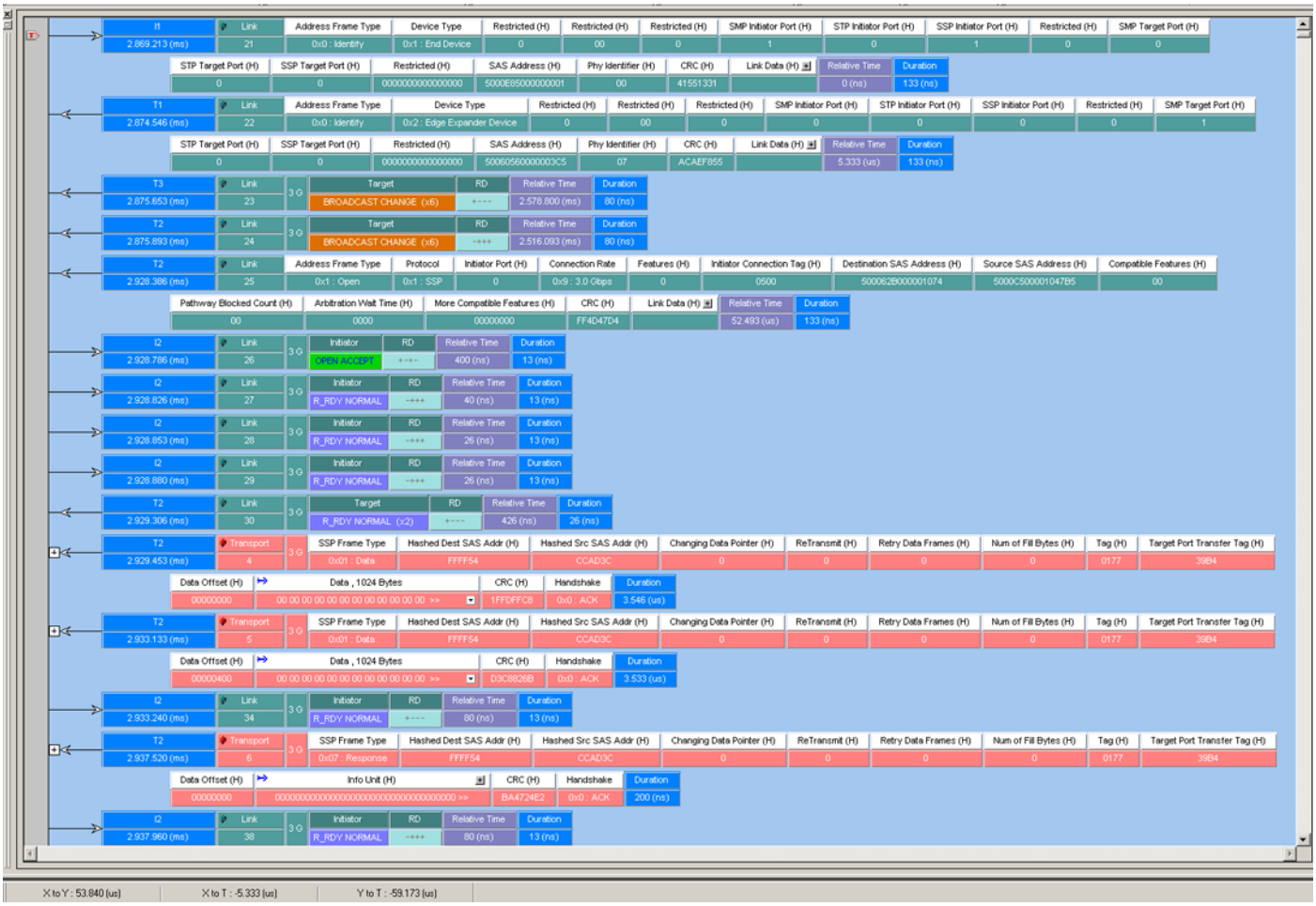


Figure 2.16: SAS: Analyzer Trace Capture Display

For details about the results display, see “Display Manipulation” on page 205 and see “Display Configuration” on page 288.

2.6.4 Patterns and Data Capture Setup

You can refine data capture by choosing **Pattern** and then selecting specific patterns for capture. Additionally, you can define a different set of patterns to capture after trigger.

To define specific patterns for capture, click the **Pattern** button to display the Capture tab for Pattern (see Figure 2.17 on page 64).

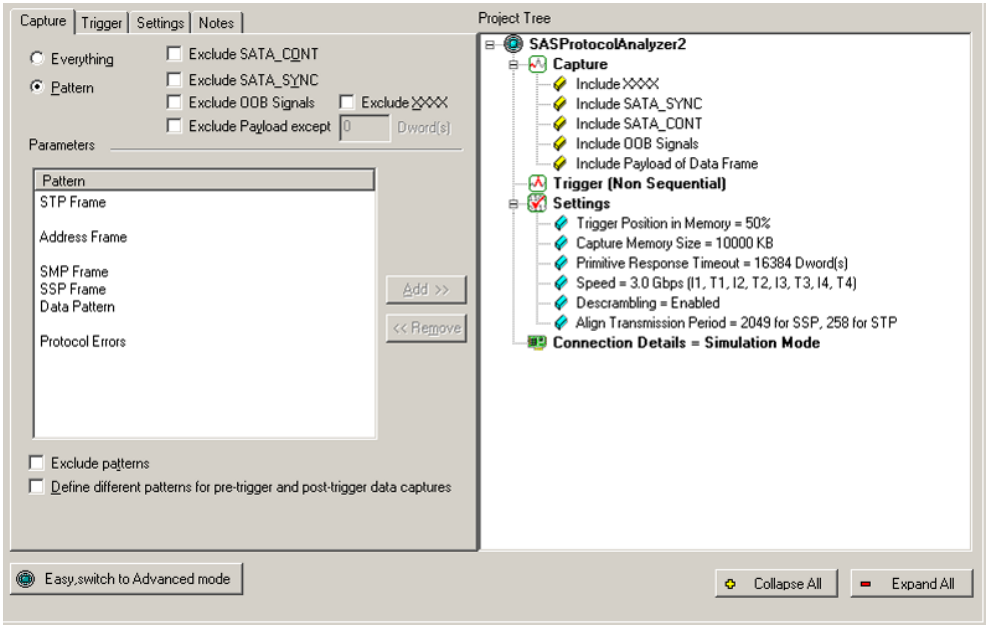


Figure 2.17: SAS: Choosing Capture Patterns

SAS vs. SATA: SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”.

SAS: The SAS Parameters window displays the following pattern capture categories:

- STP Frame
- Address Frame
- SMP Frame
- SSP Frame
- Data Pattern
- Protocol Errors

SATA: The SATA Parameters window displays the following pattern capture categories:

- FIS
- FIS Pattern
- Data Pattern
- Protocol Errors

2.6.5 Choose a Parameter

To choose a parameter for capture from any of these categories, highlight the category in the parameter window and click the **Add>>** button. This opens selection dialogs for each of the categories displaying all of the parameters for that category. All patterns added appear in the Project Tree.

2.6.6 Exclude Patterns

Check this box to allow for the capture of everything except the patterns that have been added to the Project Tree.

When you check this box, the Primitive category appears in the Parameter window, and the window enables the Exclude Idle checkbox.

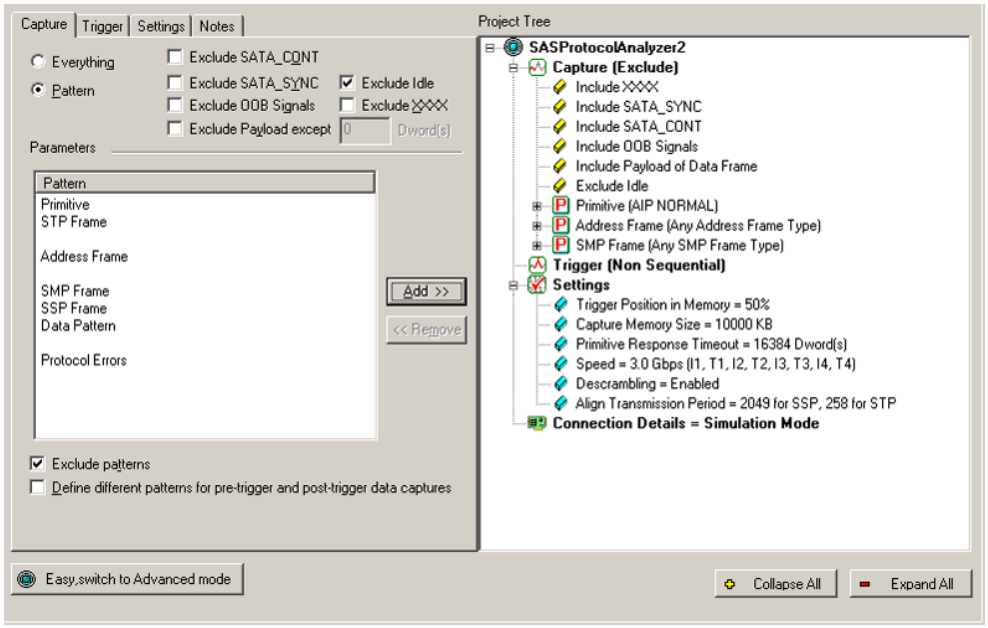


Figure 2.18: SAS: Exclude Patterns Checked

SAS vs. SATA: SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”. SATA Dialog has “ Exclude Dev Slp Packets”. SATA Dialog has different Pattern Parameters (see “Patterns and Data Capture Setup” on page 63).

To remove an item from capture, highlight it in the Project tree and click the **<<Remove** button.

2.6.7 Pre and Post Trigger Data Capture

You can define one set of patterns for capture prior to the occurrence of a trigger and another set of patterns for capture after the occurrence of a trigger. The selection and setup procedure is the same for both Pre-Trigger capture and Post-Trigger capture.

Check **Define different patterns for pre-trigger and post-trigger data capture** to enable the Pre-Trigger Capture and Post-Trigger Capture tabs (instead of only the Capture tab).

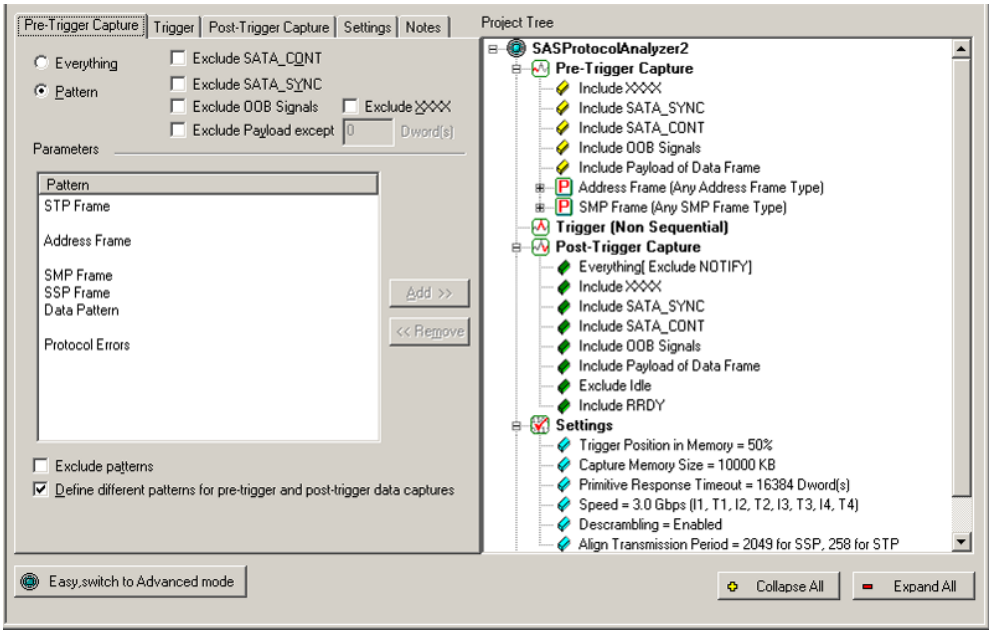


Figure 2.19: SAS: Post-trigger Capture Dialog Enabled

SAS vs. SATA: SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”. SATA Dialog has different Pattern Parameters (see “Patterns and Data Capture Setup” on page 63).

2.6.8 Defining Patterns

To select an item for capture, either highlight the category and click the **Add>>** button, or double-click the category, to open a corresponding definition dialog. You can define patterns for specific ports by checking or unchecking the Port ID (see Figure 2.20 on page 67).

Primitive

Double-click Primitive (available only if you check Exclude Patterns) to open the Primitive selection dialog.

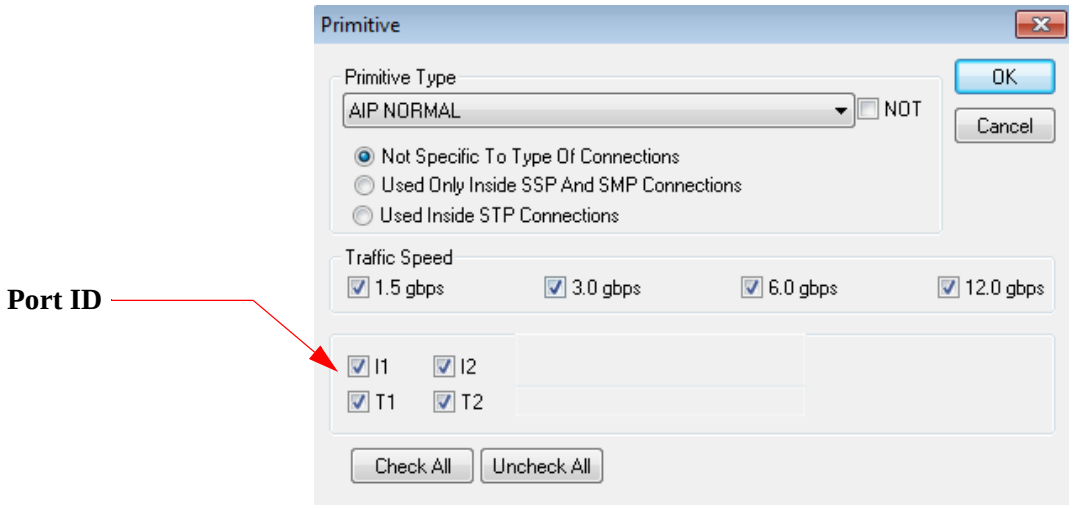


Figure 2.20: SAS: Primitive Dialog

SAS vs. SATA: SATA Dialog has no radio buttons and has different drop-down options.

Click the down arrow next to the Primitive drop-down list box, choose a Primitive to exclude, and click **OK**. Repeat for additional Primitives.

Data Pattern

Double-click Data Pattern to open the Data Pattern definition dialog.

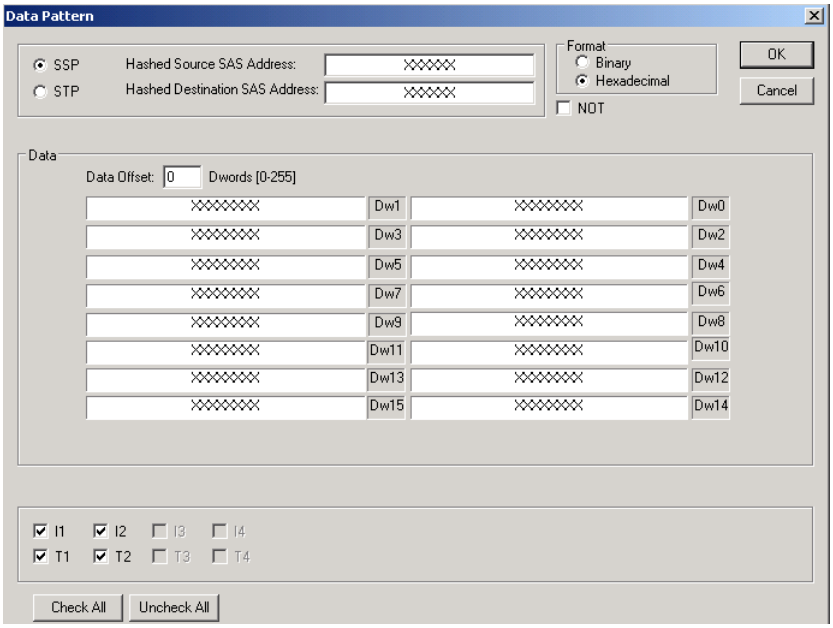


Figure 2.21: SAS: Data Pattern Dialog

SAS vs. SATA: SATA Dialog shows Port at the top and does not show SSP or STP.

Define the data pattern for capture or exclusion from capture and click **OK**.

Note: When entering the data pattern in the "Data" section of this screen, if you are reading the data pattern from a recorded trace, you must reverse the order of the bytes listed for each DWORD entered. For example, if you want to capture (or exclude) "00 01 02 03" (as displayed in the trace), you must enter this pattern as "03 02 01 00".

2.6.9 Protocol Errors

Double-click Protocol Errors to open the Protocol Errors selection dialog.

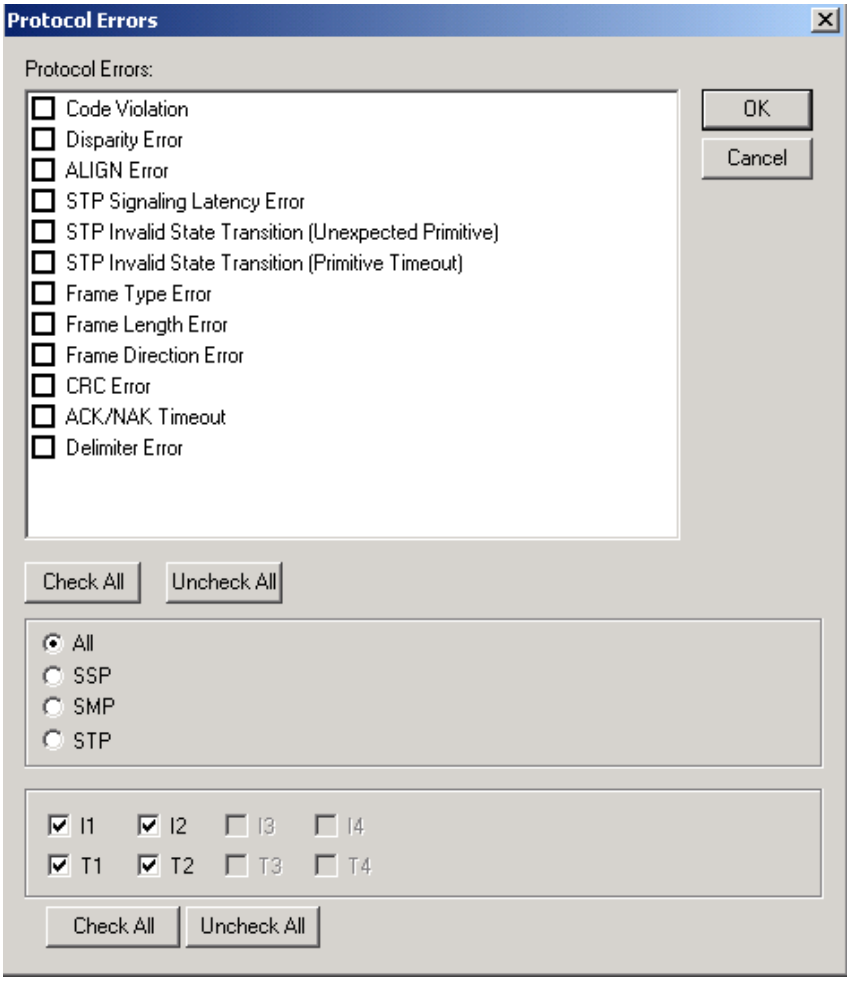


Figure 2.22: SAS: Protocol Errors Dialog

SAS vs. SATA: SATA dialog does not show ACK/NAK Timeout and has FIS signal-latency and state-transition errors, not STP ones.

Check protocol error(s) to omit or not capture, then click **OK**.

Protocol Error Descriptions

Code Violation: Wrong 10b symbol detected.

Disparity Error: Wrong disparity detected.

ALIGN Error: ALIGN primitive frequency is outside the specification requirements.

STP Signaling Latency Error [SAS only] or **FIS Signaling Latency Error [SATA only]**: DWORD difference between HOLD and HOLDA is greater than entered value in the HOLD/HOLDA Response Timeout field.

STP Invalid State Transition (Unexpected Primitive) [SAS only] or **FIS Invalid State Transition (Unexpected Primitive) [SATA only]**: Second SATA_SOF is encountered before SATA_EOF, and other unexpected primitives.

STP Invalid State Transition (Primitive Timeout) [SAS only] or **FIS Invalid State Transition (Primitive Timeout) [SATA only]**: Timeout between two paired primitives is above entered value. 65000 DWORDs is default. For example, it can occur between WTRM and R_OK, or X_RDY and R_RDY. It expects device (or host) to send a response, but response is not received after 65000 DWORDs. You can configure Primitive Response Timeout and HOLD/HOLDA Response Timeout in the Settings tab Analyzer Settings section.

Frame Type Error: Wrong frame type.

Frame Length Error: Reported frame length is different than actual frame length:

Frame Direction Error: Wrong frame direction. For example, Register Device to Host coming from the Host.

CRC Error: CRC error detected.

ACK/NAK Timeout [SAS only]: ACK or NAK primitive missing or encountered unexpectedly.

Disable “Disparity Error” and “Symbol Violation” during the Speed negotiation: No longer detects Code Violation or Disparity Error. <Amit, is this removed?>

Delimiter Error: Detects two SOF primitives without an EOF between them. Also detects two EOF primitives without an SOF between them.

2.6.10 STP Frame

Double-click STP Frame to open the STP Frame Type dialog (Figure 2.23 on page 70).

.

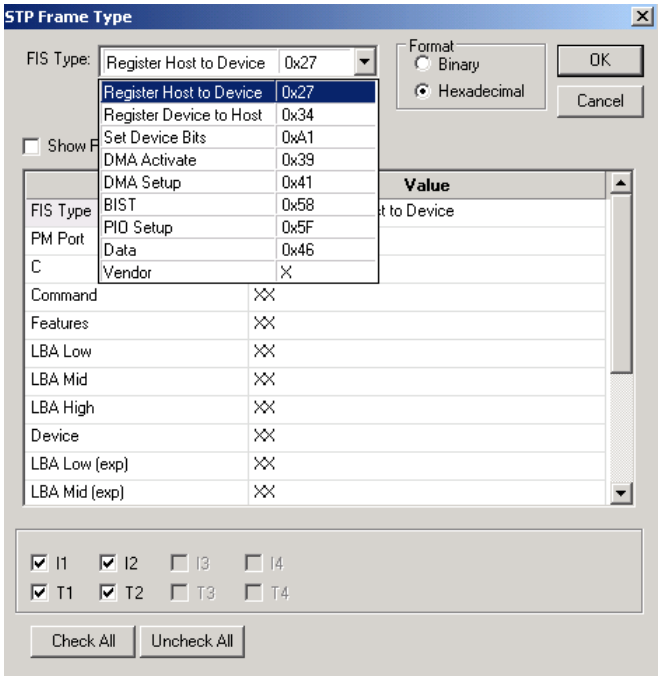


Figure 2.23: FIS Patterns Dialog

Click the down arrow next to the FIS Type drop-down list box, choose a FIS type to capture or exclude, and click **OK**. Repeat for additional types.

Available FIS Types

- Register Host to Device
- Register Device to Host
- Set Device Bits
- DMA Activate
- DMA Setup
- BIST
- PIO Setup
- Data
- Vendor

2.6.11 Address Frame (SAS only)

Double-click Address Frame to open the Address Frame Type Pattern dialog (Figure 2.24 on page 71).

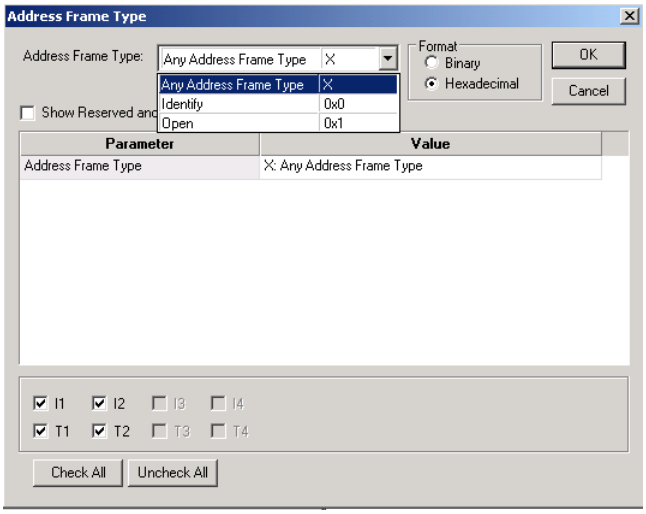


Figure 2.24: SAS: Address Frame Type Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the Address Frame Types list box and choose an address frame type.

2.6.12 SMP Frame (SAS only)

Double-click SMP Frame to open the SMP Frame Pattern dialog.

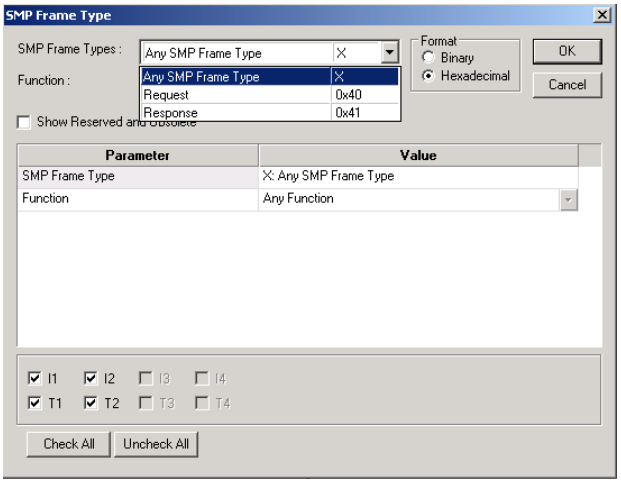


Figure 2.25: SAS: SMP Frame Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SMP Frame Type list box and choose a frame type. Assign a specific function to the frame by clicking the down arrow next to the Function list box and choose a function.

2.6.13 SSP Frame (SAS only)

Double-click SSP Frame to open the SSP Frame Pattern dialog.

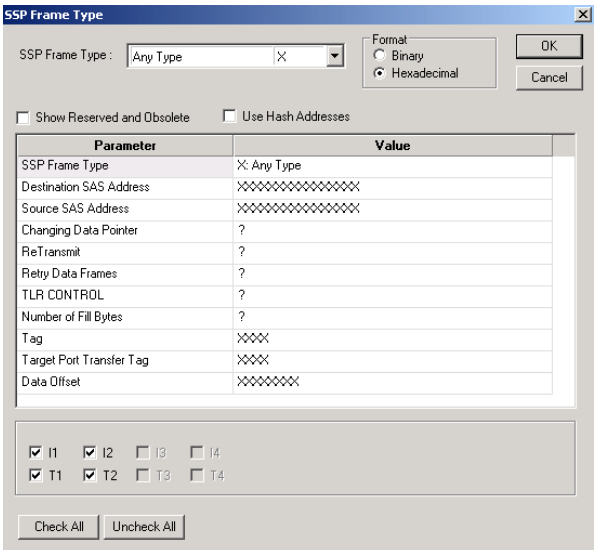


Figure 2.26: SAS: SSP Frame Type Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SSP Frame Type list box and choose an SSP Frame type.

2.6.14 FIS Type (Frame Information Structure) (SATA only)

Double-click FIS to open the FIS Type selection dialog.

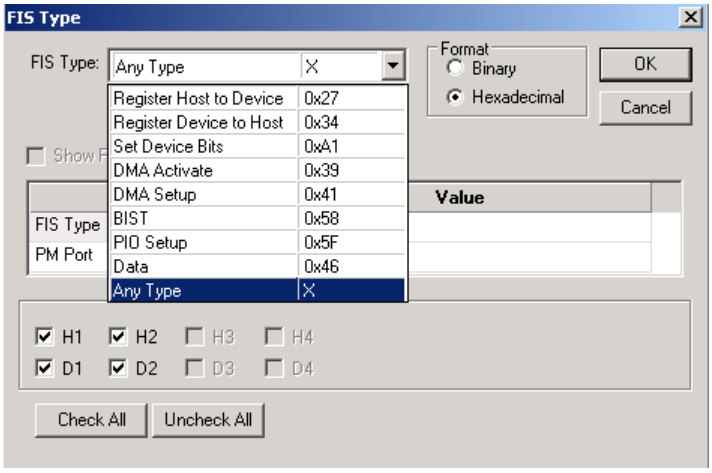


Figure 2.27: SATA: FIS Types Dialog

SAS vs. SATA: Not available in SAS.

Click the down arrow next to the Type drop-down list box, choose a **FIS** type to capture, and click **OK**. Repeat for additional types.

Available FIS Types

- Register Host to Device
- Register Device to Host
- Set Device Bit
- DMA Activate
- DMA Setup
- BIST
- PIO Setup
- Data
- Any Type

2.6.15 STP Frame Pattern

Double-click STP Pattern to open the STP Pattern selection dialog.

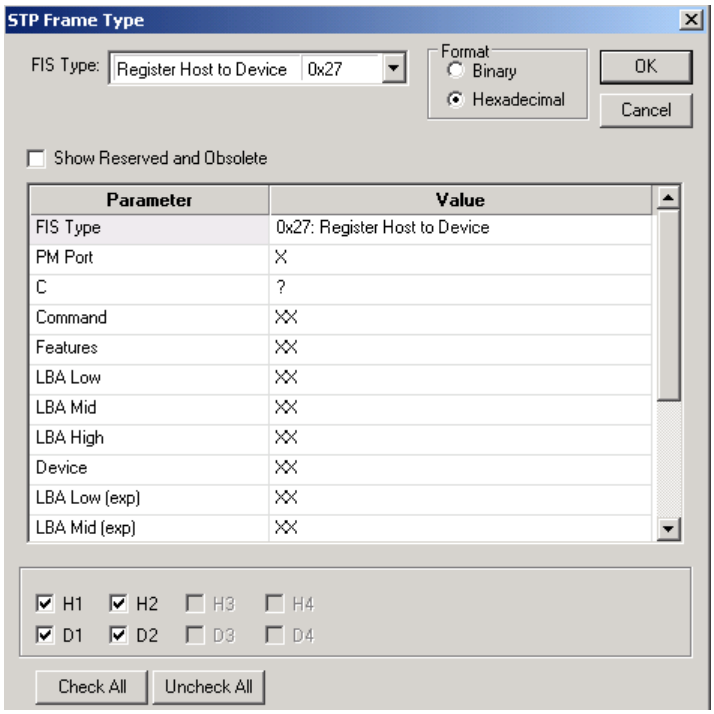


Figure 2.28: SATA: STP Pattern Dialog

The STP Pattern dialog opens with the default FIS Type as **Register Host to device.** To choose another available FIS Type, click the down arrow next to the FIS Type list box.

Choose FIS Type and complete the corresponding dialog.

Register Host to Device

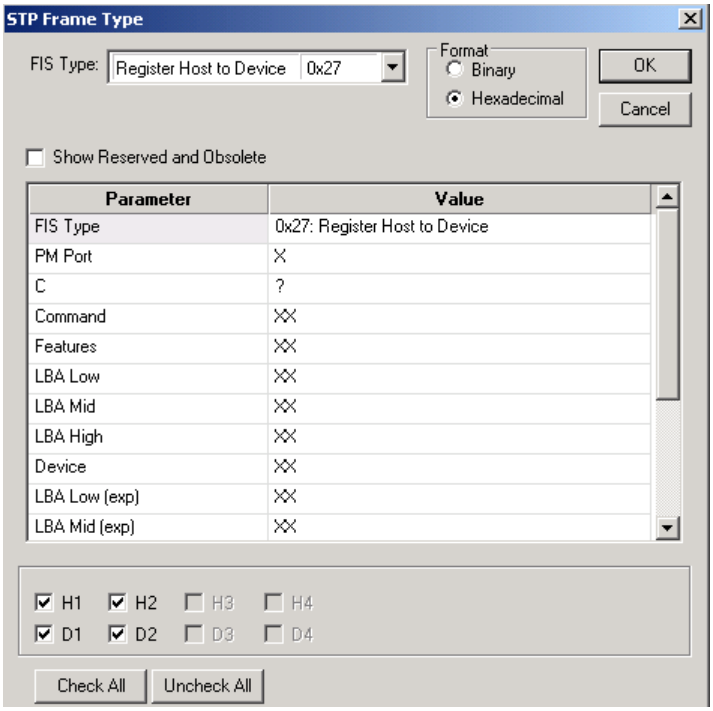


Figure 2.29: Register Host to Device

Register Device to Host

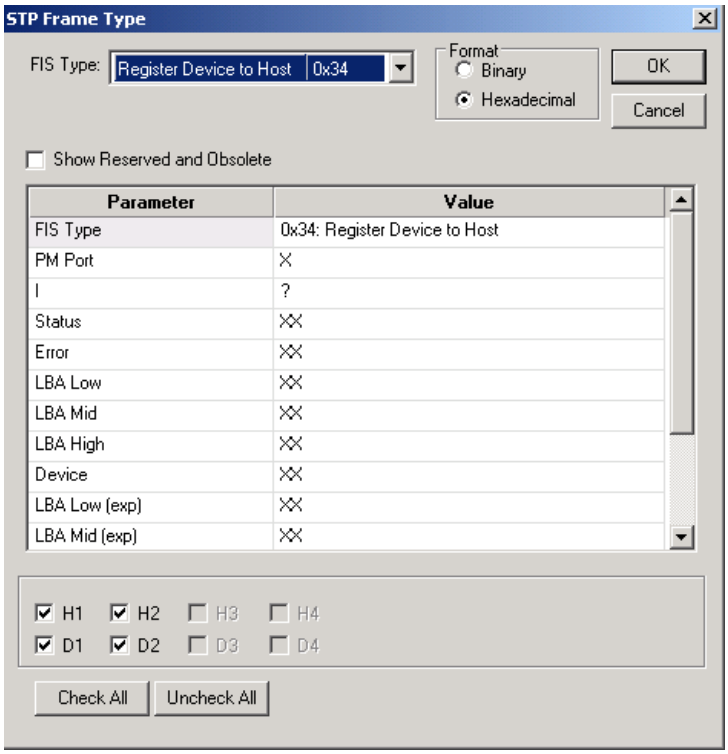


Figure 2.30: Register Device to Host

Set Device Bits

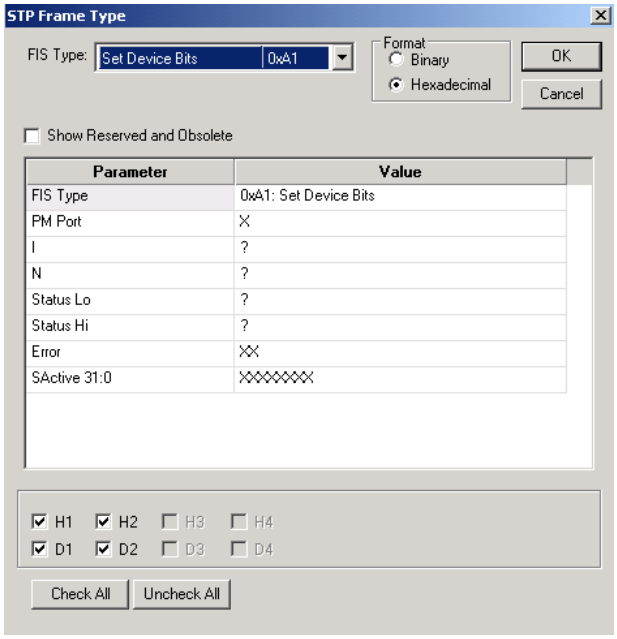


Figure 2.31: Set Device Bits

DMA Activate

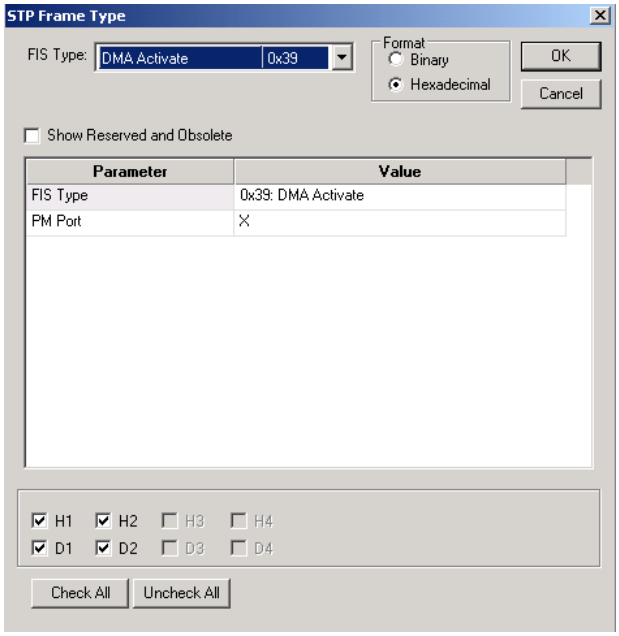


Figure 2.32: DMA Activate

DMA Setup

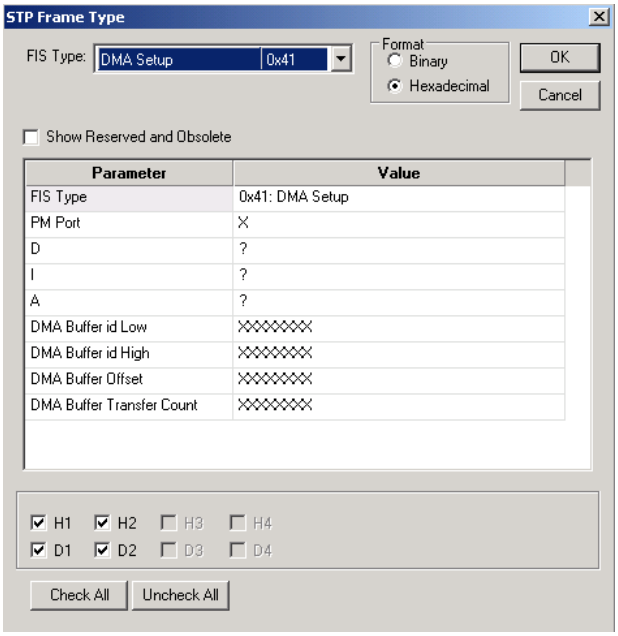


Figure 2.33: DMA Setup

BIST

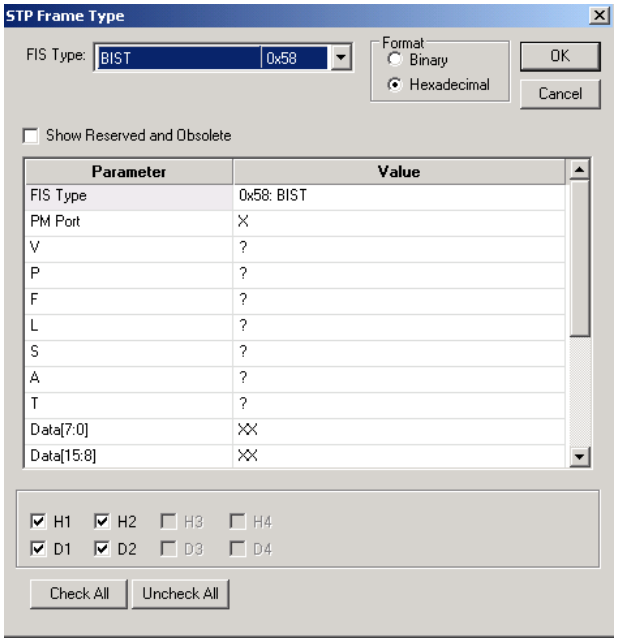


Figure 2.34: BIST

PIO Setup

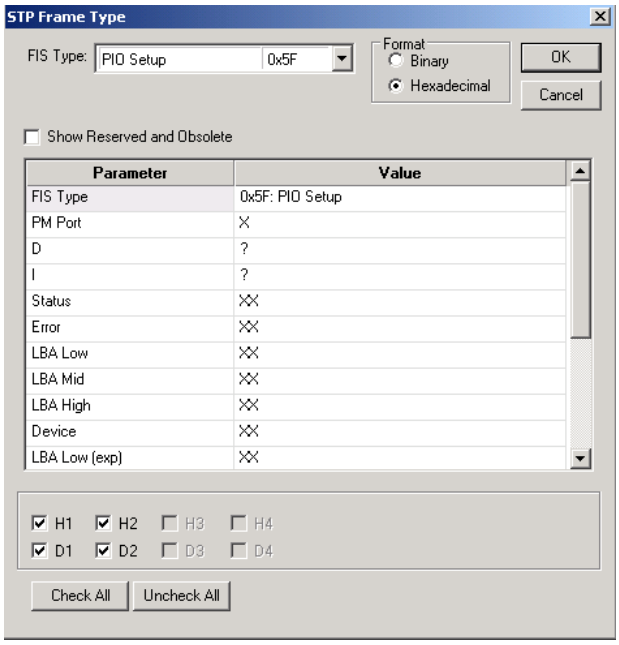


Figure 2.35: PIO Setup

Data

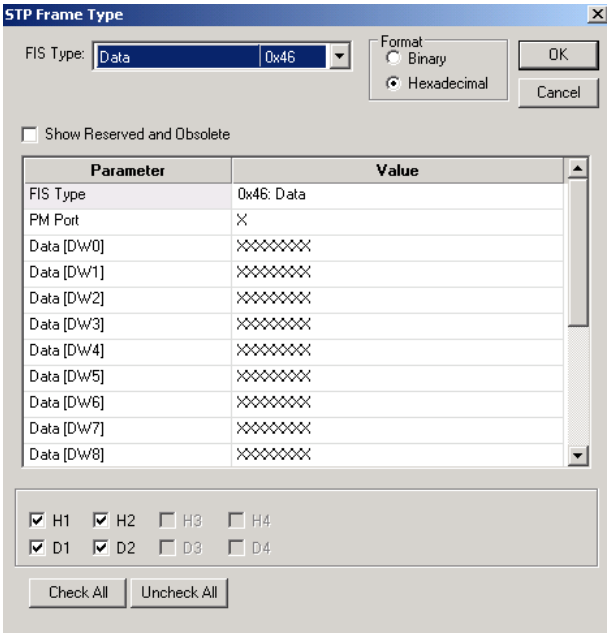


Figure 2.36: Data

Vendor

Vendor is for FIS Pattern.

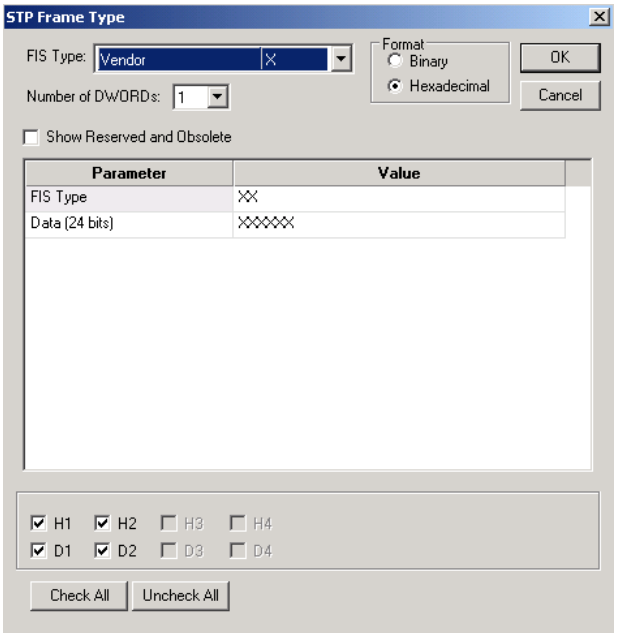


Figure 2.37: Vendor

2.6.16 Trigger Setup

The **Trigger** tab in the analysis project dialog allows you to specify when the analyzer completes a data capture. Three trigger modes are available:

- Don’t care (Snapshot) is the default
- Manual Trig
- Pattern

When data capture starts with **Don’t care (Snapshot)** selected, the analyzer triggers on the first data pattern on the bus.

Starting a data capture with **Pattern** selected triggers when specific pattern(s) are detected in the captured data stream. The following three ways can trigger the analyzer with **Pattern** selected.

- Trigger on any pattern (Any Trigger Mode)
- External Trigger
- Trigger on a sequence of patterns (Sequential Trigger Mode)

Snapshot Mode

To trigger immediately on any pattern, check the **Don't care (Snapshot)** button.

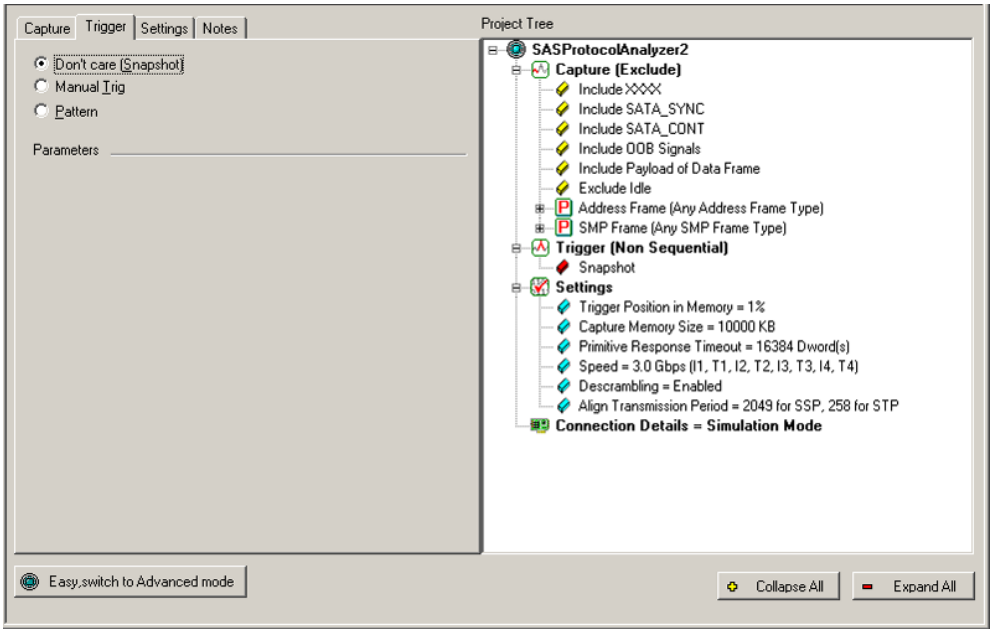


Figure 2.38: Default Trigger Selected

Manual Trigger Mode

To perform a manual trigger, check the **Manual Trig** radio button. In the **Manual Trigger** mode, the analyzer captures bus traffic continually from when you use the Manual Trigger until you click the **Stop Recording** button (on the analyzer toolbar), which triggers the analyzer. Clicking the **Manual Trigger** button on the application toolbar creates a Trigger Event and uploads the trace with the specified trigger position.

Any Trigger in Pattern Mode

In **Pattern** mode, the Analyzer triggers whenever any of the patterns selected for triggering occurs (an OR condition). The procedure for selecting trigger parameters is identical to that for selecting capture parameters. All items selected for triggering appear in the Project Tree.

To define patterns for triggering, check the **Pattern** button in the Trigger dialog (see Figure 2.39 on page 80).

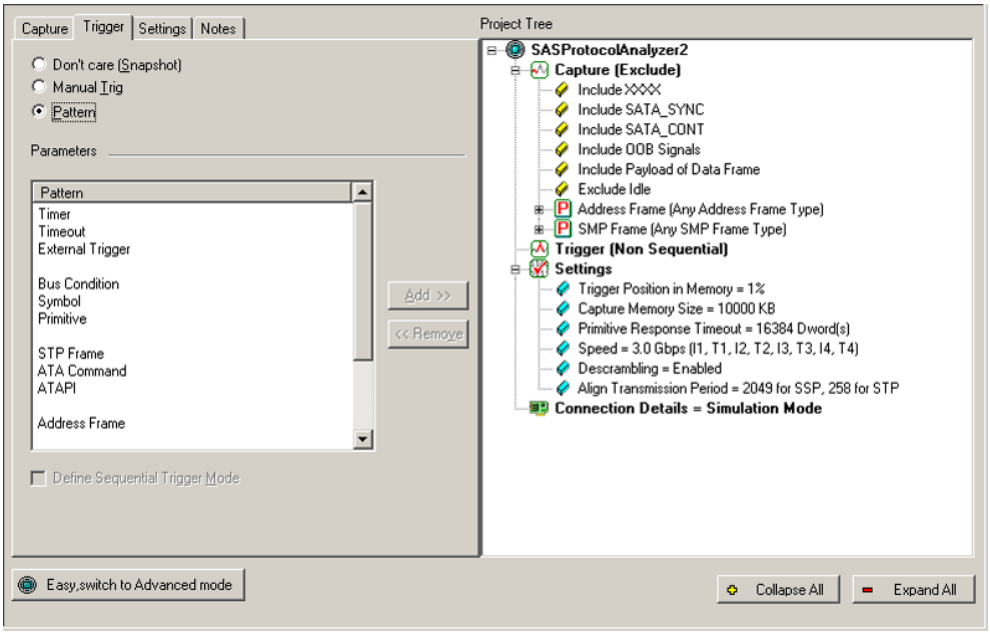


Figure 2.39: SAS: Select Patterns for Trigger

The SAS **Parameters** window displays the following trigger pattern categories:

- Timer
- Timeout
- External/Manual Trigger
- Device Sleep
- Bus Condition
- Symbol
- Primitive
- STP Frame
- ATA Command
- ATAPI
- Address Frame
- SMP Frame
- SSP Frame
- SCSI Command
- Data Pattern
- Training Sequence
- Protocol Errors

Define Sequential Trigger Mode

This is enabled when more than one pattern is used. It allows for the use of a simple state machine of “pattern A then pattern B”. When checked, the Count field in each pattern’s dialog is enabled (see Figure 2.40 on page 81).

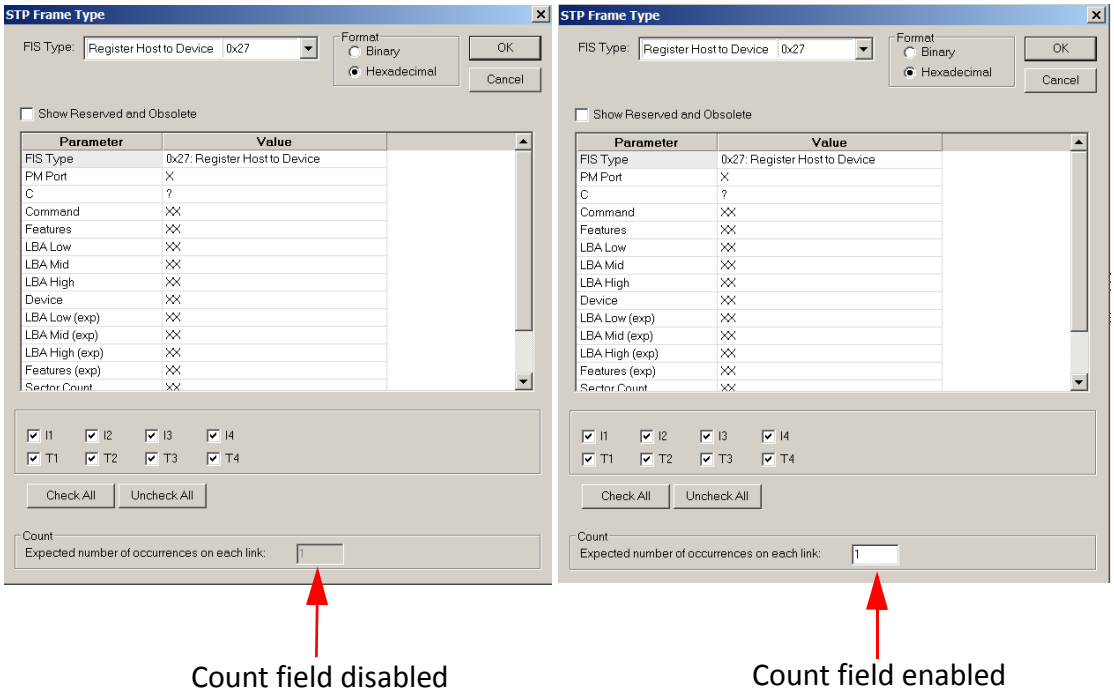


Figure 2.40: Count Field Dialog

The SATA **Parameters** window displays the following trigger pattern categories:

- Timer
- Timeout
- External/Manual Trigger
- Device Sleep
- Bus Condition
- Symbol
- Primitive
- FIS
- FIS Pattern
- STP Frame
- ATA Command
- ATA Command Pattern
- ATAPI
- Soft Reset
- Data Pattern
- Protocol Errors

Note: In packet view, you can right-click on any frame, select **Add to Trigger**, and add the pattern to **DataPatternCapture** to make it a trigger pattern.

Choosing a Parameter

Either highlight the category and click the Add>> button, or double-click the category, to open a corresponding definition dialog.

To remove an item, highlight it in the Project Tree, then click the **<<Remove** button.

Triggering on a Timer

Triggering based on a timer means that the trigger is activated when the timer expires. Other triggers can preempt the timed trigger while it is counting down the time. The timer starts when the project s started.

You can set a timer independently of any other trigger selection, to cause an unconditional trigger after a set time.

To set the timer value, double-click **Timer** in the Pattern window to open the Timer dialog.

Figure 2.41: Timer Dialog

Check a Time Unit, enter the Timer Value, and click OK.

Timeout

Selecting **Timeout** for the pattern opens the Timeout Pattern dialog.

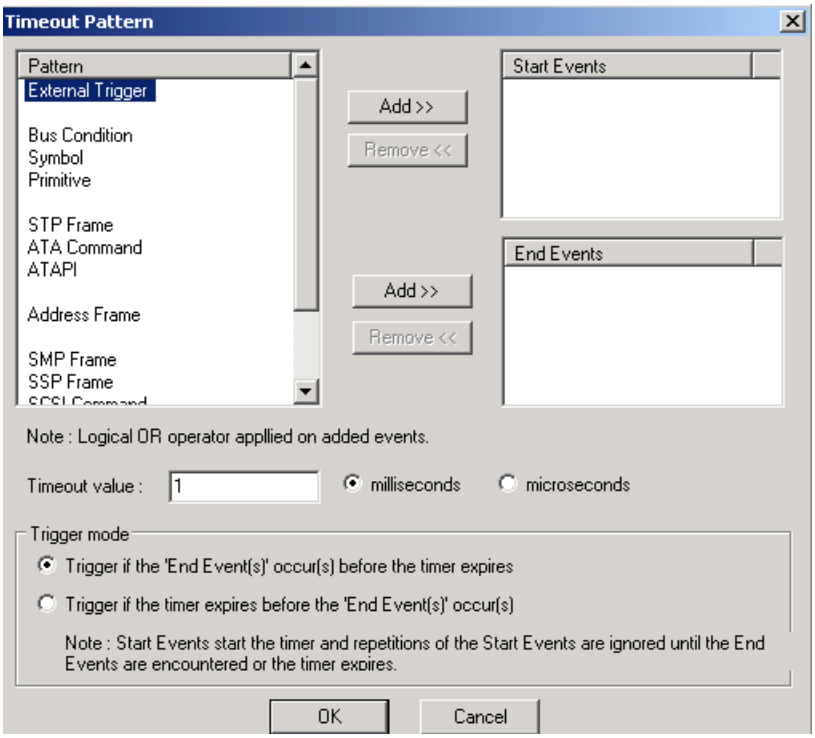


Figure 2.42: Timeout Dialog

"Start Events" starts the timer in Timeout Trigger and "End Events" triggers the analyzer (if first trigger mode is selected) or resets the trigger (if second trigger mode is selected). Repetitions of the Start Events are ignored until the End Event is encountered or the timer expires.

Select a pattern for Start Events or End Events, enter a Timeout value, then select Trigger Mode:

- If End Events occur before timer expires
- If timer expires before End Events

Note: Timeouts can only be configured from the Timeout Pattern dialog. The Timeout Pattern dialog allows configuring other patterns as triggers in combination with timeouts. Other pattern dialogs do not allow configuration of timeouts.

External/Manual Trigger

To set up an external or manual trigger. To set up the trigger, click the **External/ Manual Trigger** category.

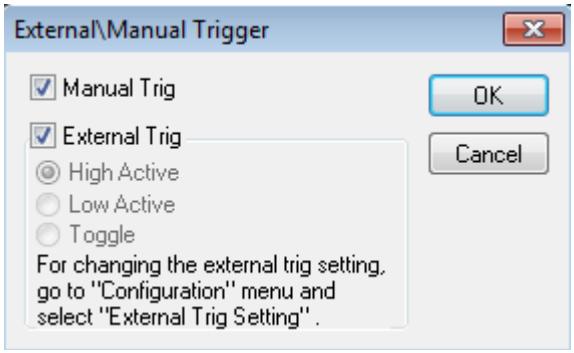


Figure 2.43: External/Manual Trigger Dialog

Device Sleep

To set up Device Sleep click the **Device Sleep** category. Select **Rising Edge** or **Falling Edge**.

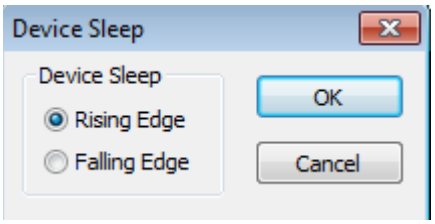


Figure 2.44: Device Sleep Dialog

Bus Condition

Double-click **Bus Condition** in the Pattern window to open the Bus Conditions dialog.

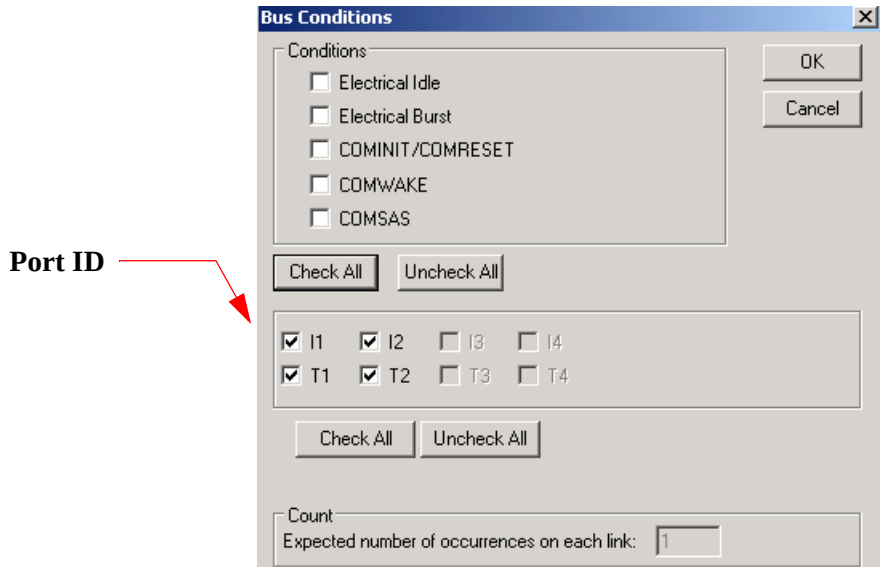


Figure 2.45: SAS: Bus Conditions Dialog

SAS vs. SATA: SATA Dialog separates the COMINIT and COMRESET check boxes and replaces COMWAKE with Host COMWAKE and COMSAS with Device COMWAKE.

Check Conditions on which to trigger, then click **OK**.

Note: You can define triggering for specific ports by checking or unchecking Port IDs.

Symbol

Double-click **Symbol** in the Pattern window to open the Symbol dialog.

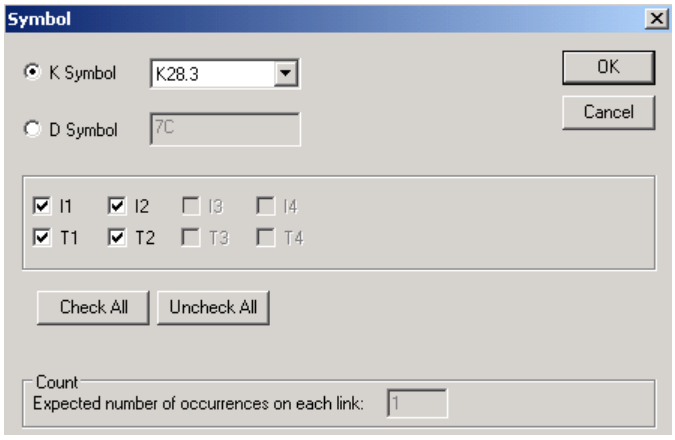


Figure 2.46: Symbol Dialog

Choose a symbol type by checking either the K Symbol or D Symbol option, then click the down arrow in the Symbol dropdown list, choose a symbol to trigger on, and click **OK**. Note that the D Symbol choice does not have a down arrow.

To choose a **D symbol**, click the D symbol option button and enter a Hex value.

Primitive

Double-click **Primitive** in the Patterns window of the Trigger dialog to open the Primitive dialog. The radio buttons select a different subset of primitives from an approximate total of 88 that are available. This makes it easier to find the right primitive. The Count field is enabled when the Define Sequential Trigger Mode check-box is selected (see Figure 2.40 on page 81).

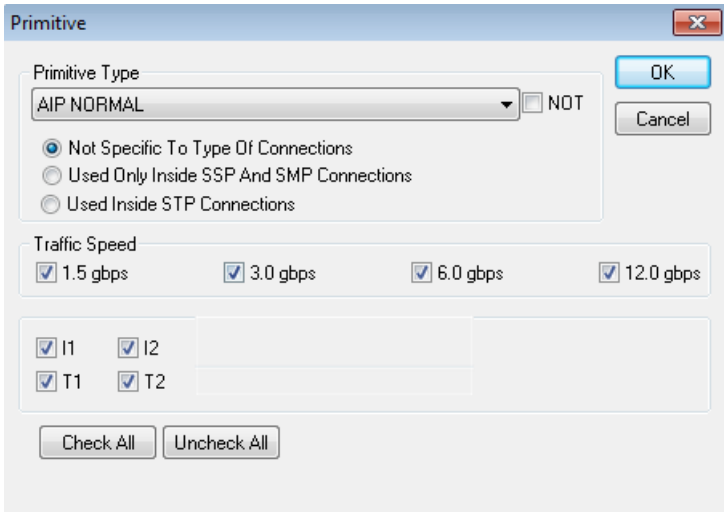


Figure 2.47: SAS: Primitive Dialog

SAS vs. SATA: SATA Dialog has no radio buttons and has different drop-down options.

Click the down arrow next to the Primitive dropdown list, scroll the list to choose a primitive on which to trigger, and click **OK**.

Note: Check the box to the right of the Primitive Type to use the logical NOT.

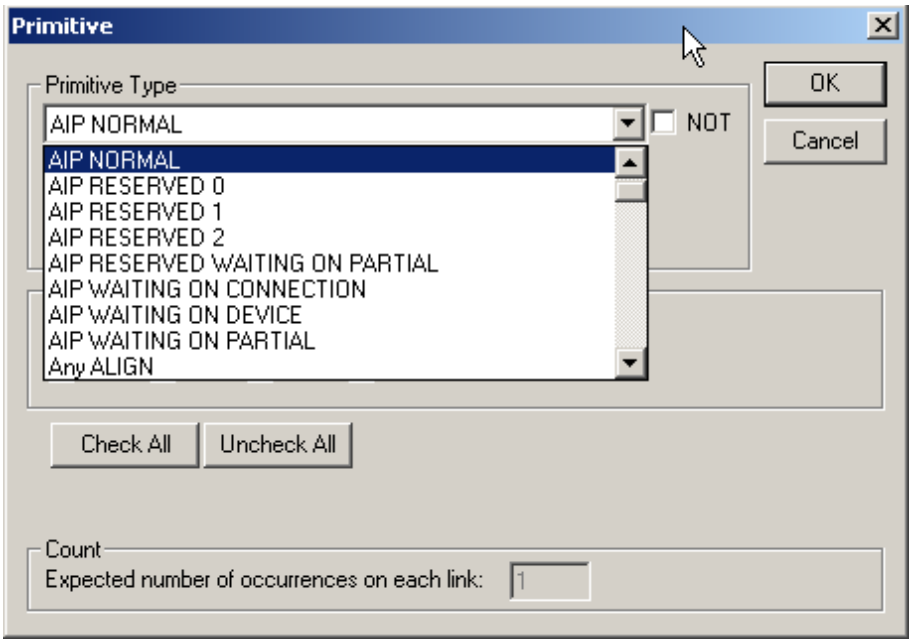


Figure 2.48: SAS: Primitive Selection Choices

SAS vs. SATA: SATA Dialog has different choices.

Primitive Traffic Speed Option (SATA only)

You can change the speed for triggering as well as search by speed for Primitives.

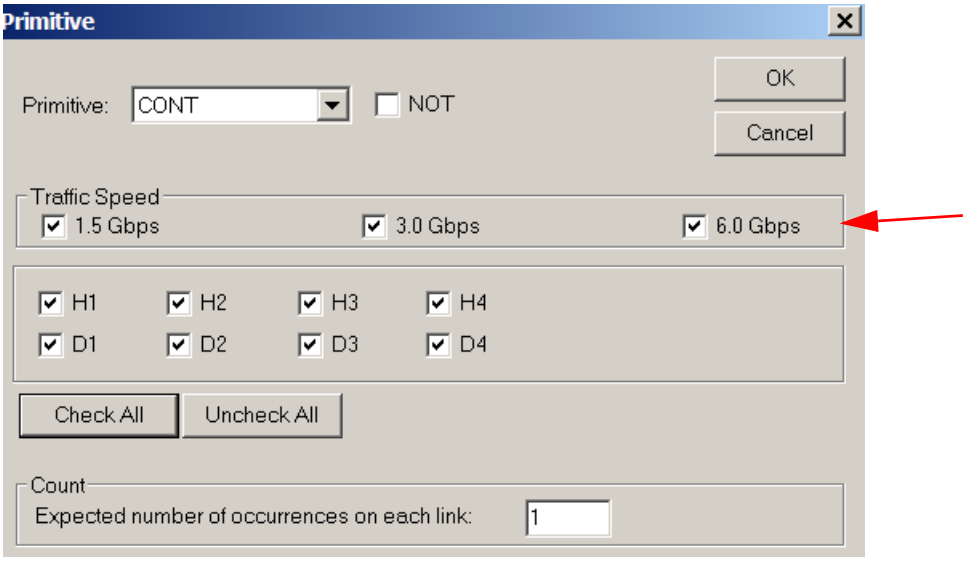


Figure 2.49: Primitive Dialog

ATA Command

Double-click **ATA Command** in the Pattern window to open the ATA Command Pattern dialog.

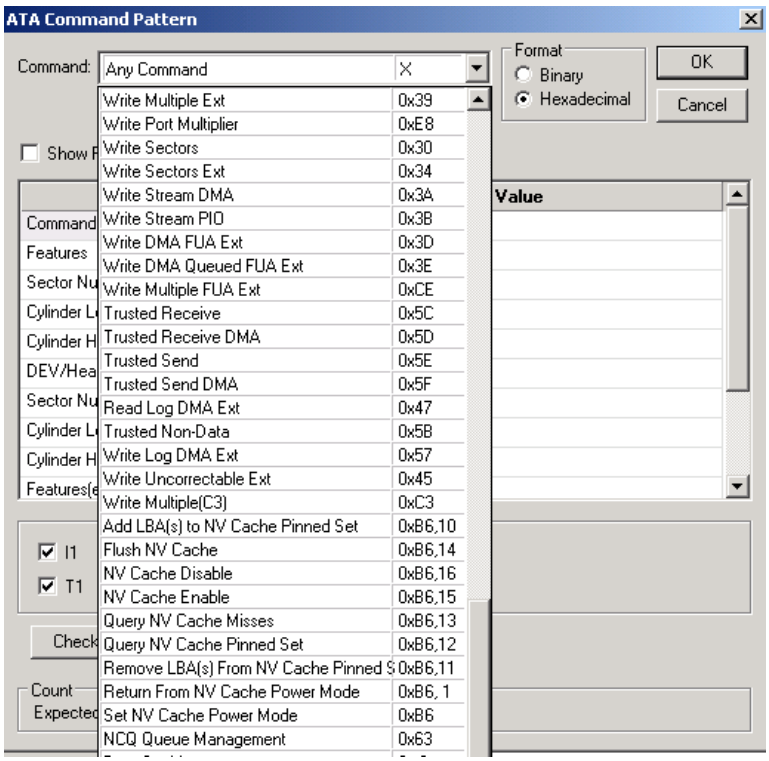


Figure 2.50: SAS: ATA Command Pattern Dialog

SAS vs. SATA: SATA Dialog has different dropdown options.

Choose a Command from the drop-down list and click **OK**.

A powerful triggering choice is **Any Command**, which causes the analyzer to trigger on any ATA command.

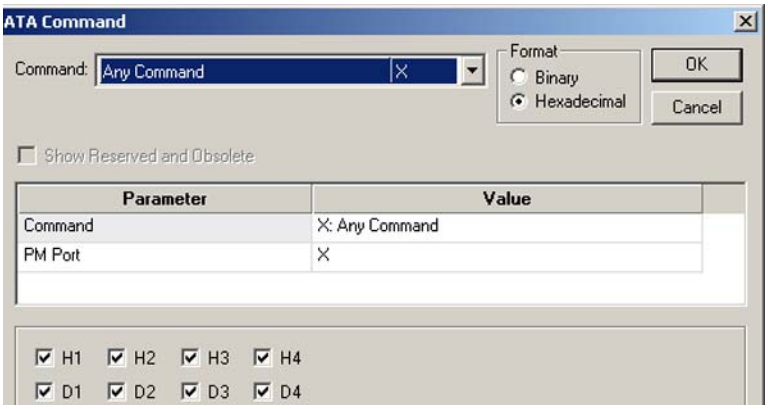


Figure 2.51: SATA: ATA Command Dialog

Choose a Command from the drop-down list and click **OK**.

Note: The command code and feature set are not the only parameters that describe an ATA command. For parameters such as LBA and sector count, use the **ATA Command Pattern** dialog.

ATAPI

Double-click **ATAPI** in the Pattern window to open the ATAPI Pattern dialog.

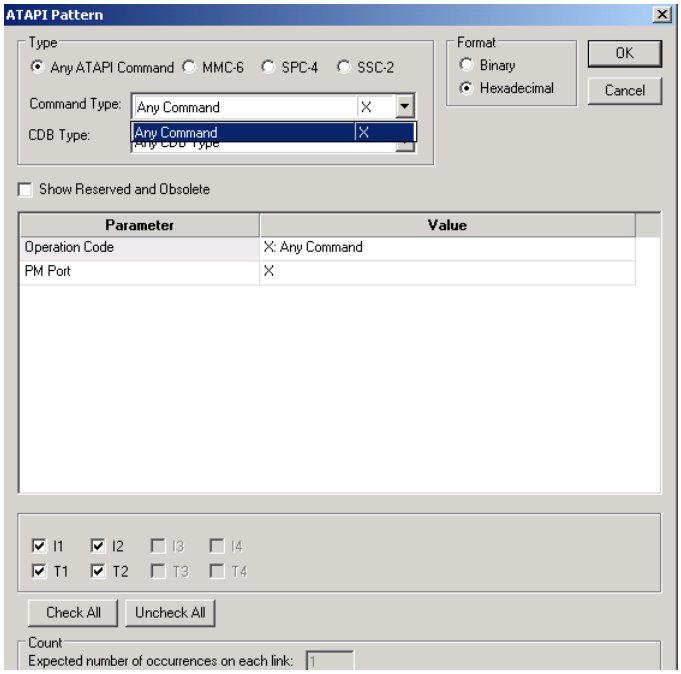


Figure 2.52: SAS: ATAPI Pattern Dialog

SAS vs. SATA: SATA Dialog has different dropdown options.

Choose a CDB from the drop-down list and click **OK**.

Data Pattern

Double-click **Data Pattern** in the Pattern window to open the Data Pattern dialog.

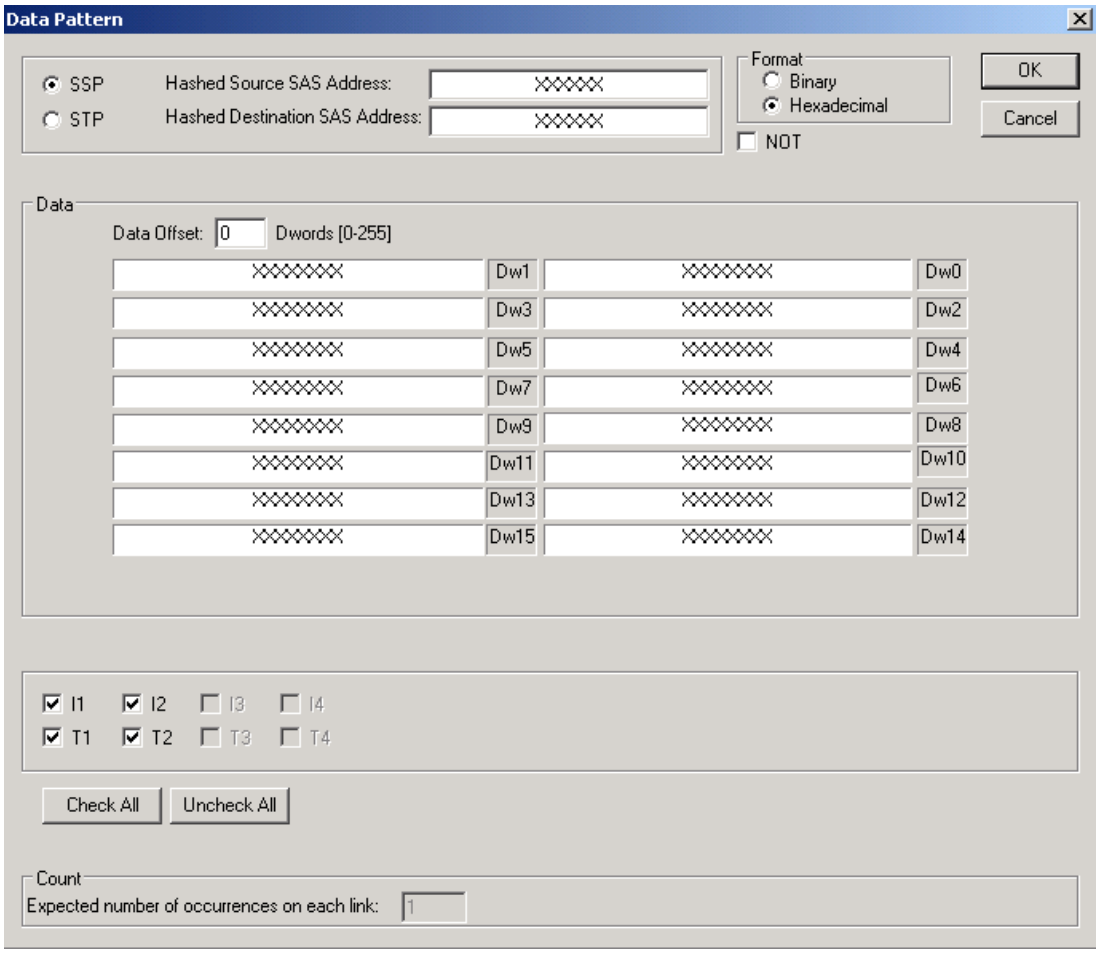


Figure 2.53: SAS: Data Pattern Dialog

SAS vs. SATA: SATA Dialog shows Port at the top and does not show SSP or STP.

Define the data pattern for triggering and click **OK**.

Note: When entering the data pattern in the "Data" section of this screen, if you are reading the data pattern from a recorded trace, you must reverse the order of the bytes listed for each DWORD entered. For example, if you want to trigger on "00 01 02 03" (as displayed in the trace), you must enter this DWORD pattern as "03 02 01 00".

Protocol Errors

Double-click Protocol Errors in the Pattern window to open the Protocol Errors dialog.

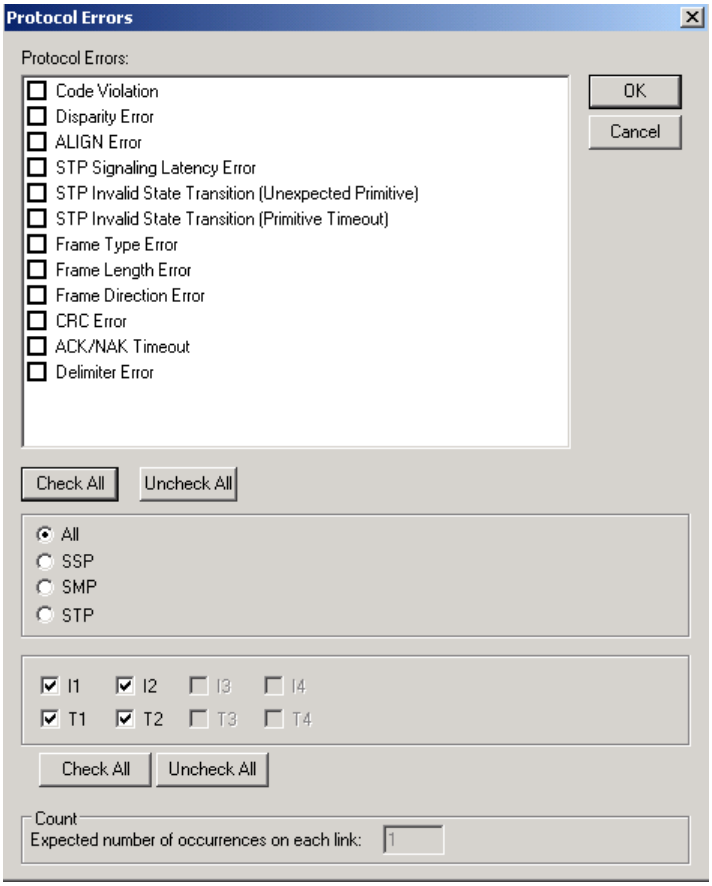


Figure 2.54: SAS: Protocol Errors Dialog

SAS vs. SATA: SATA Dialog shows Port and does not show SSP, SMP, or STP radio buttons.

Check the protocol error(s) to trigger on and click **OK**.

STP Frame

Double-click **STP Frame** in the Pattern window to open the FIS Pattern dialog.

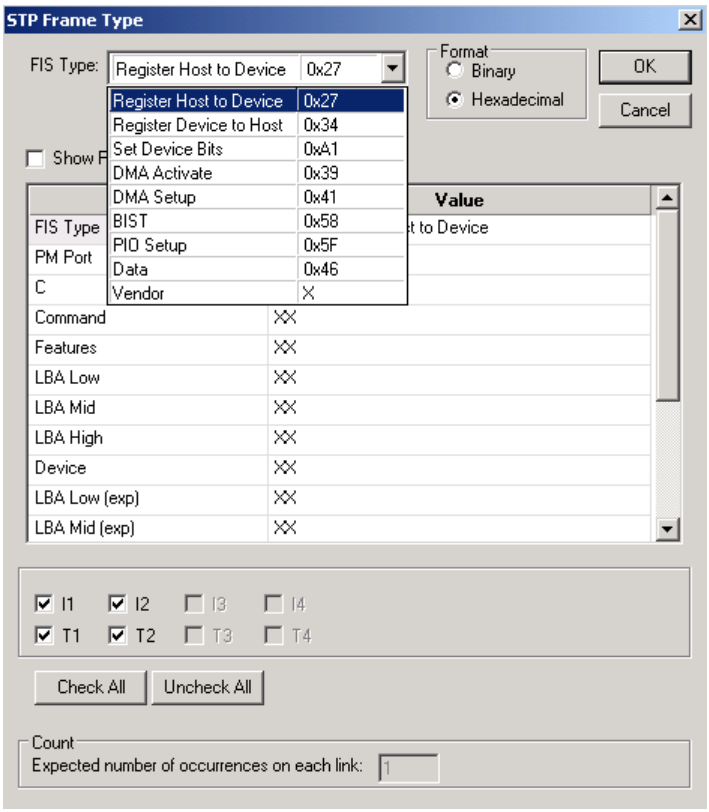


Figure 2.55: SAS: FIS Pattern Dialog

SAS vs. SATA:

Choose a FIS type from the drop-down list and click **OK**.

Address Frame (SAS only)

Double-click Address Frame in the Pattern window to open the Address Frame Type Pattern dialog.

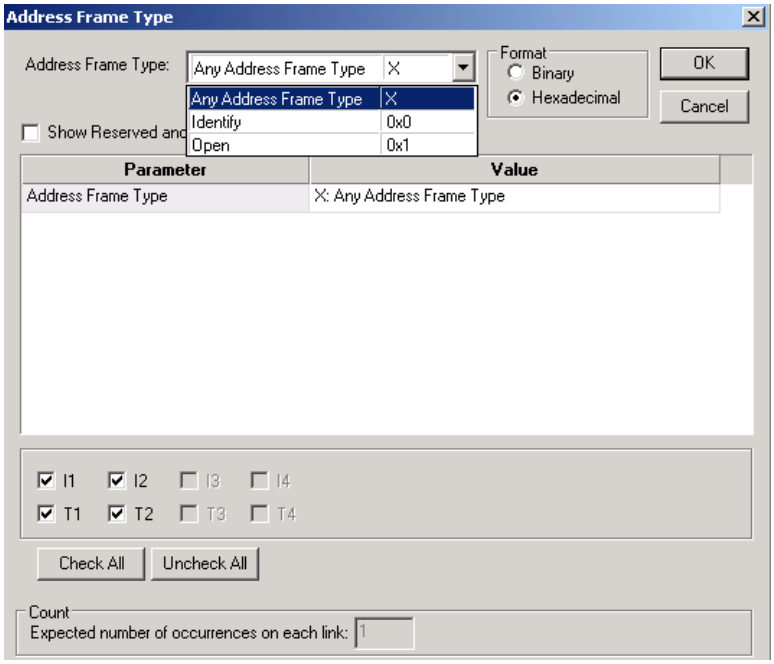


Figure 2.56: SAS: Address Frame Type Pattern Dialog

SAS vs. SATA: Not available in SATA.

Choose an Address Frame Type from the drop-down list and click **OK**.

SMP Frame (SAS only)

Double-click SMP Frame in the Pattern window to open the SMP Frame Pattern dialog.

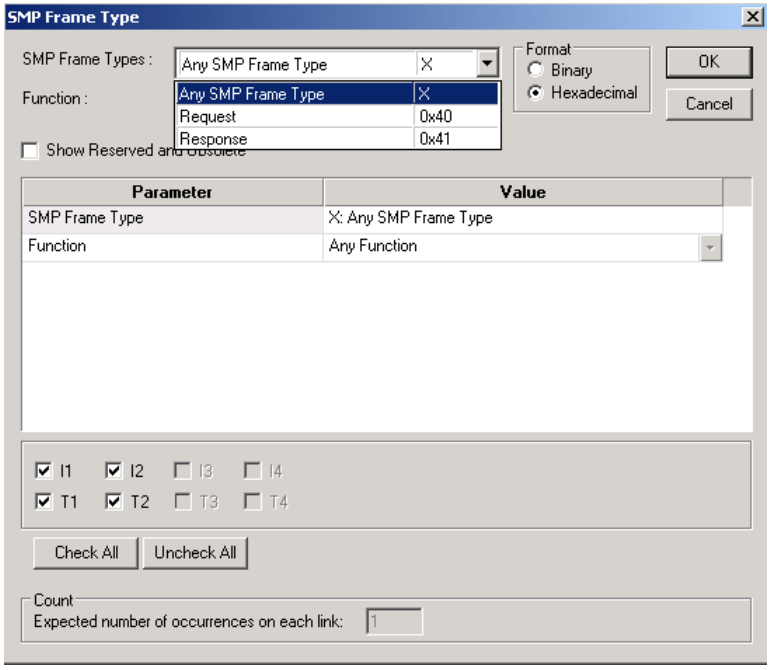


Figure 2.57: SAS: SMP Frame Pattern Dialog

SAS vs. SATA: Not available in SATA.

Choose a SMP Frame Type and Function from the drop-down list and click **OK**.

SSP Frame (SAS only)

Double-click SSP Frame in the Pattern window to open the SSP Frame Type dialog.

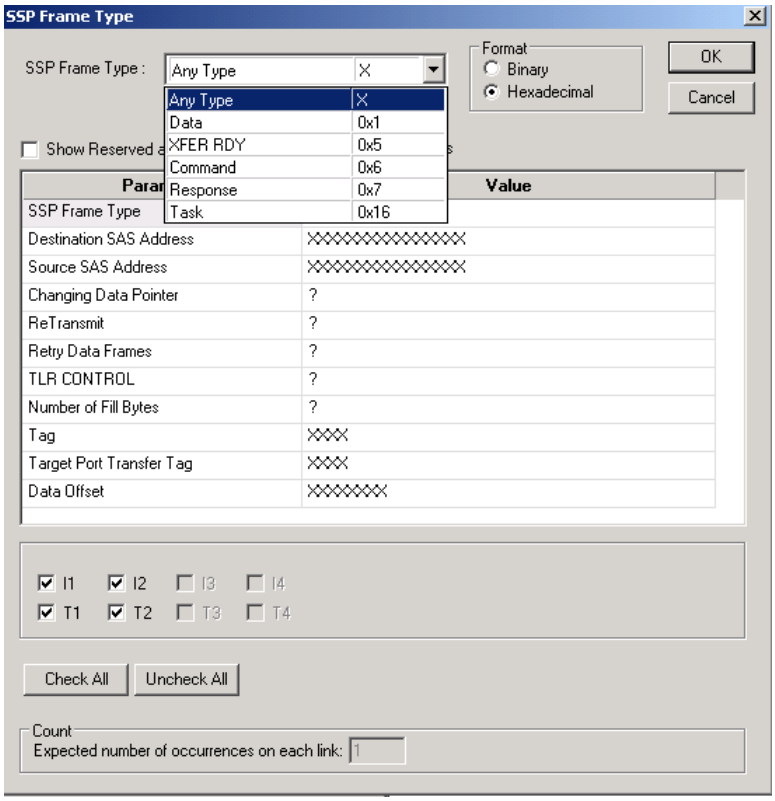


Figure 2.58: SAS: SMP Frame Type Dialog

SAS vs. SATA: Not available in SATA.

Choose a SSP Frame Type from the drop-down list and click **OK**.

SCSI Command (SAS only)

Double-click SCSI Command in the Pattern window to open the SCSI Command Pattern dialog.

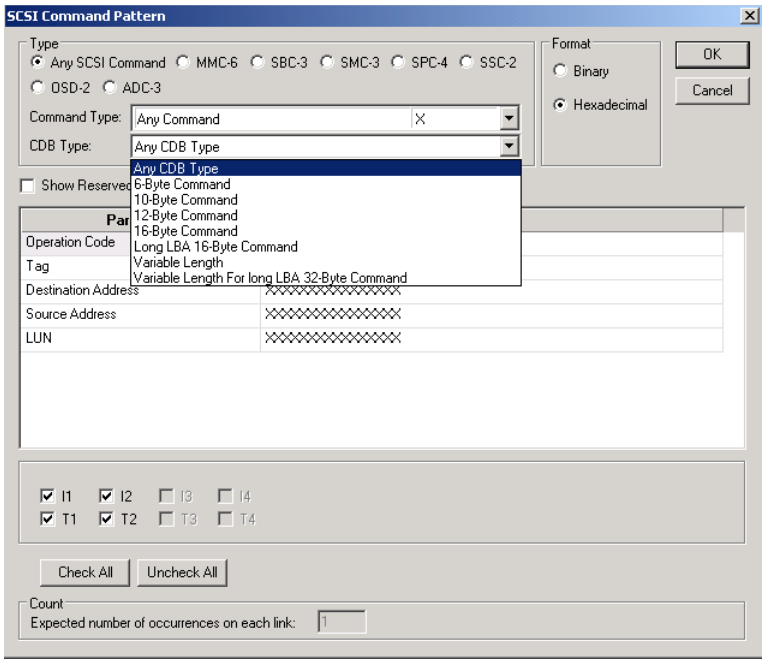


Figure 2.59: SAS: SCSI Command Pattern Dialog

SAS vs. SATA: Not available in SATA.

Choose a CDB from the drop-down lis and click **OK**.

FIS (Frame Information Structure) (SATA only)

Double-click **FIS** to open the FIS Type selection dialog.

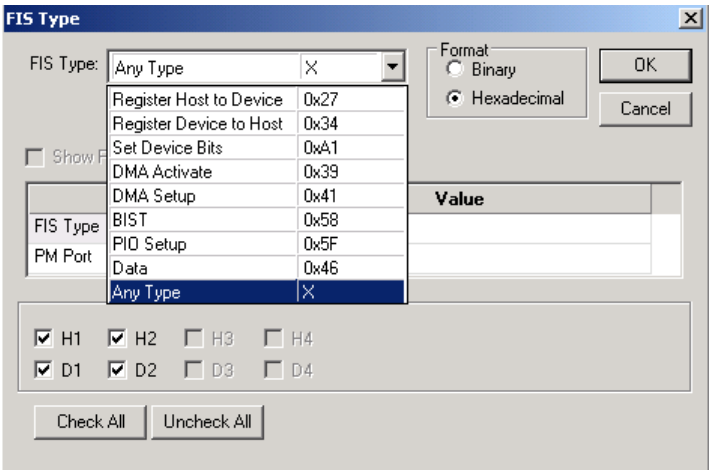


Figure 2.60: SATA: FIS Type Dialog

SAS vs. SATA: Not available in SAS.

Choose a FIS Type from the drop-down list boxand click **OK.** Repeat for additional types.

Available FIS Types:

- Register Host to Device
- Register Device to Host
- Set Device Bit
- DMA Activate
- Any Type
- DMA Setup
- BIST
- PIO Setup
- Data

Note: You cannot trigger on a Vendor FIS.

FIS Pattern (SATA only)

Double-click **FIS Pattern** to open the FIS Pattern selection dialog.

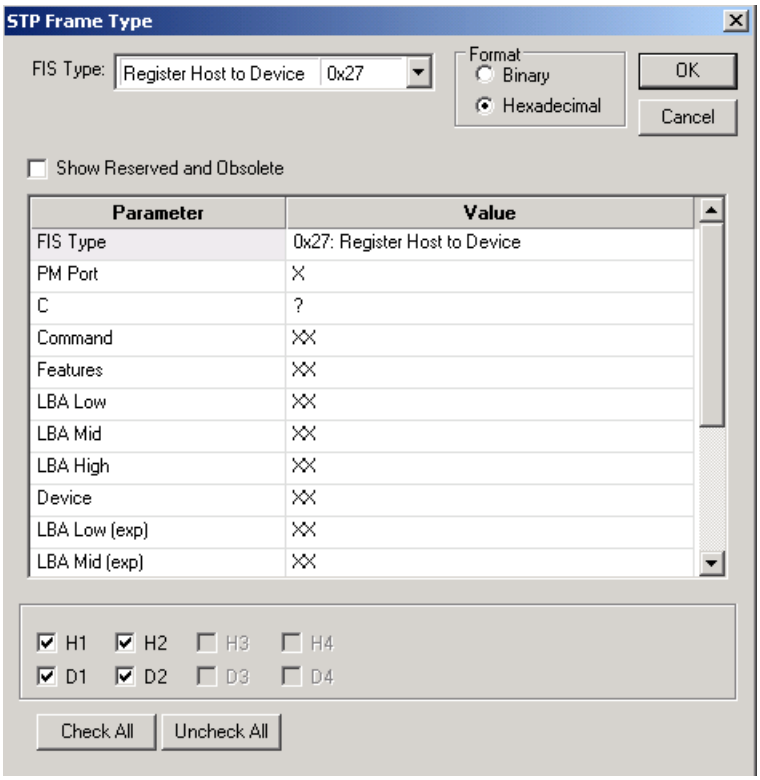


Figure 2.61: SATA: FIS Pattern Dialog

SAS vs. SATA: Not available in SAS.

The FIS Pattern dialog opens with the default FIS Type **Register Host to device.** To choose another available FIS Type, click the down arrow next to the FIS Type list box.

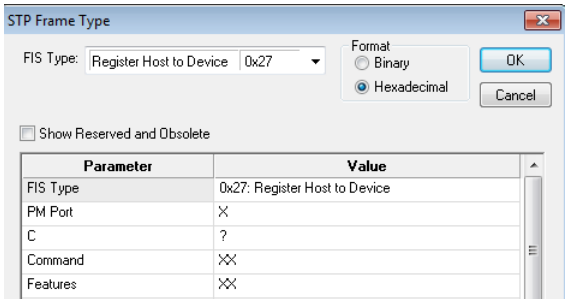


Figure 2.62: SATA: FIS Pattern Dialog Choices

SAS vs. SATA: Not available in SAS.

Choose a FIS Type and complete the corresponding dialog.

ATA Command Pattern

Double-click **ATA Command** to open the ATA Command Pattern selection dialog.

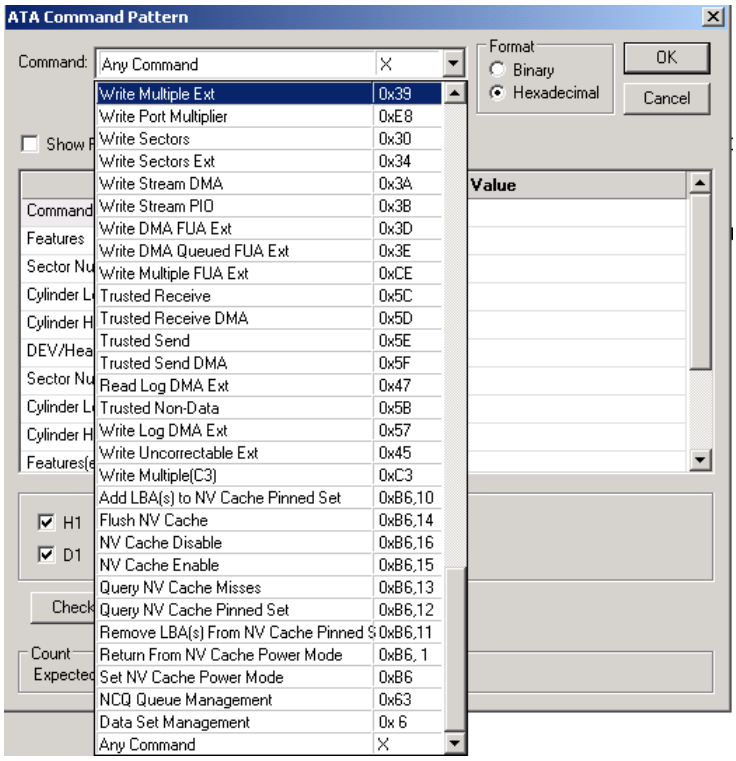


Figure 2.63: SATA: ATA Command Pattern Dialog

Choose an ATA command from the drop-down list and click **OK**.

Soft Reset (SATA only)

Double-click **Soft Reset** to open the Soft Reset dialog.

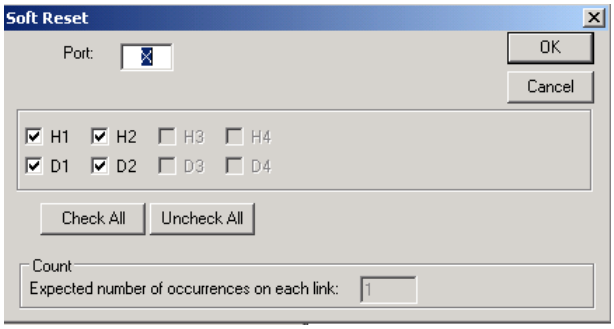


Figure 2.64: SATA: Soft Reset Dialog

SAS vs. SATA: Not available in SAS.

Sequential Trigger Mode

In Sequential Trigger mode, triggering occurs whenever the system detects a specific sequence of patterns. Defining the triggering patterns sets the sequence order. You must define at least two patterns to enable selection of Sequential Trigger mode.

Note: Patterns, such as Primitives and Symbols or Frames, occurring very close together on different ports can cause false triggers.

To define a triggering sequence, select more than one pattern, then check the **Define Sequential Trigger Mode** check box. See "Define Sequential Trigger Mode" on page 80 for more information.

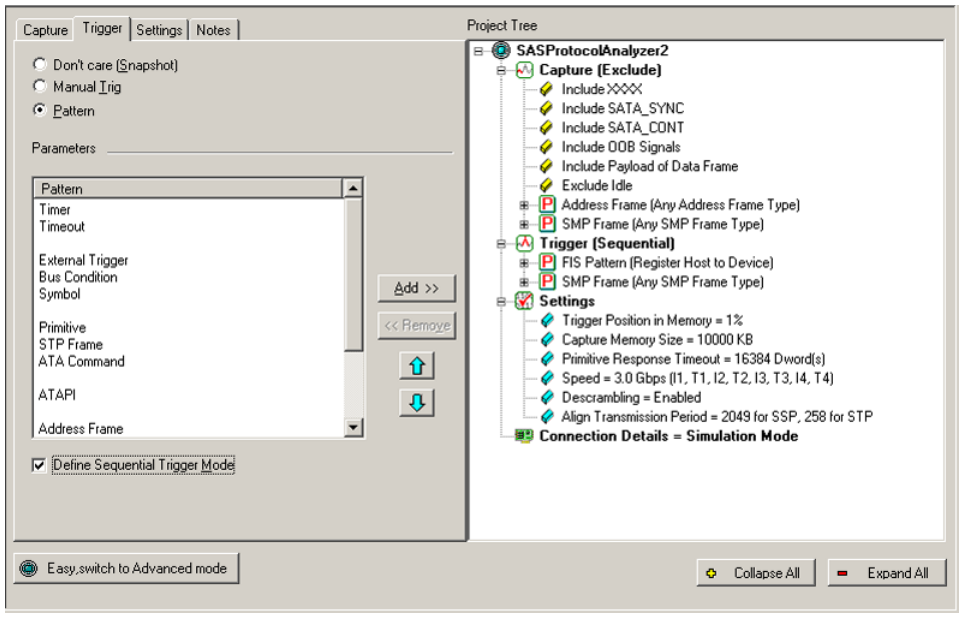


Figure 2.65: SAS: Select Sequential Trigger Mode

SAS vs. SATA: SATA Dialog has different patterns.

Timer

The sequential triggering mode offers the option of triggering on a timer or inserting a timer in the triggering sequence to delay detection of the next pattern in the sequence. To insert a timer in the trigger list, double-click Timer to open the Timer dialog.

Figure 2.66: Timer Dialog

Enter a **Timer Value**, choose the Time Unit, and click **OK**.

Defining Patterns

The definition of patterns for the sequential trigger mode is identical to the Any Trigger mode, with the following exception:

In sequential triggering mode, the definition dialogs for the triggering patterns enable the setting to count the number of occurrences. This allows you to specify the number of times that the pattern must occur before triggering or proceeding in the trigger sequence.

Figure 2.67: Number of Occurrences DIalog

Note: The events on each link are counted independently, causing a trigger whenever the number of occurrences on any link equals the specified value.

Triggering Order

As you define and add triggering patterns, they display under the Trigger category in the Project Tree sequentially, in the order in which you entered them. When the project runs, the analyzer detects the occurrence of each pattern in order and triggers on the last one.

You can re-order the sequence of triggering patterns. To change the sequence order, highlight a trigger pattern and use the **Up** or **Down** arrow to move it to a new position.

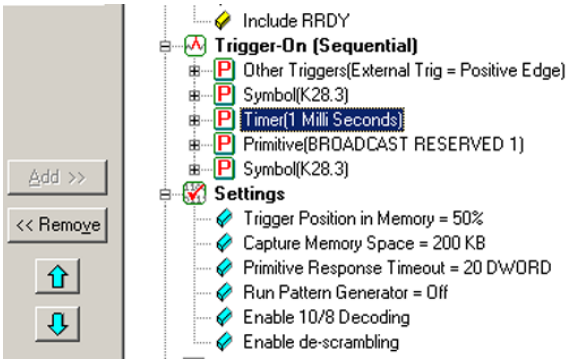


Figure 2.68: Triggering Order

Pre-Trigger

You can set the amount of data to capture before and after the trigger, as a percentage of pre-trigger, between 1% and 99%. Position the pre-trigger slider to a percentage. This feature allows the evaluation of bus activity leading up to and after the triggering event. Figure 2.69 illustrates the operation of pre-trigger in data memory.

Pre-trigger data is capture of the specified percentage of data prior to the triggering event. It cannot be guaranteed and may be 0. This can occur when the triggering event occurs before storing the required amount of pre-trigger event data. In such a case, the data display shows fewer than the specified data points prior to the triggering event.

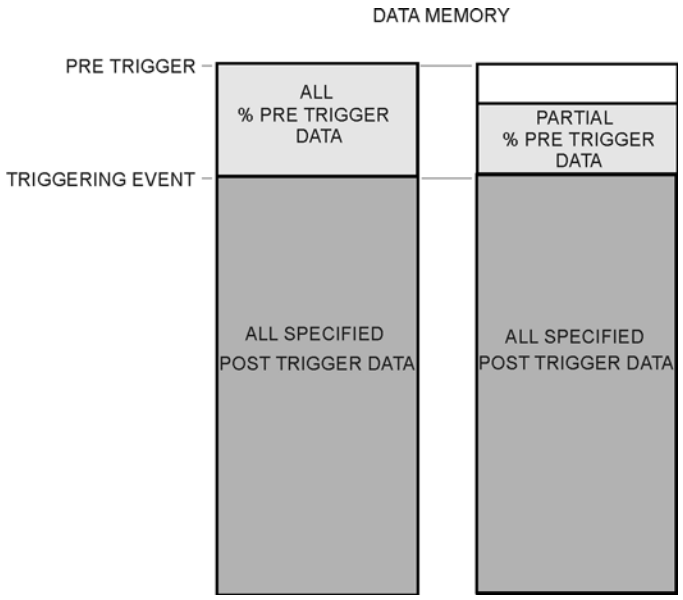


Figure 2.69: Pre-Trigger Example, 20% Pre-Trigger

2.6.17 Project Settings

To set project options, click the **Settings** tab (Figure 2.70 on page 102).

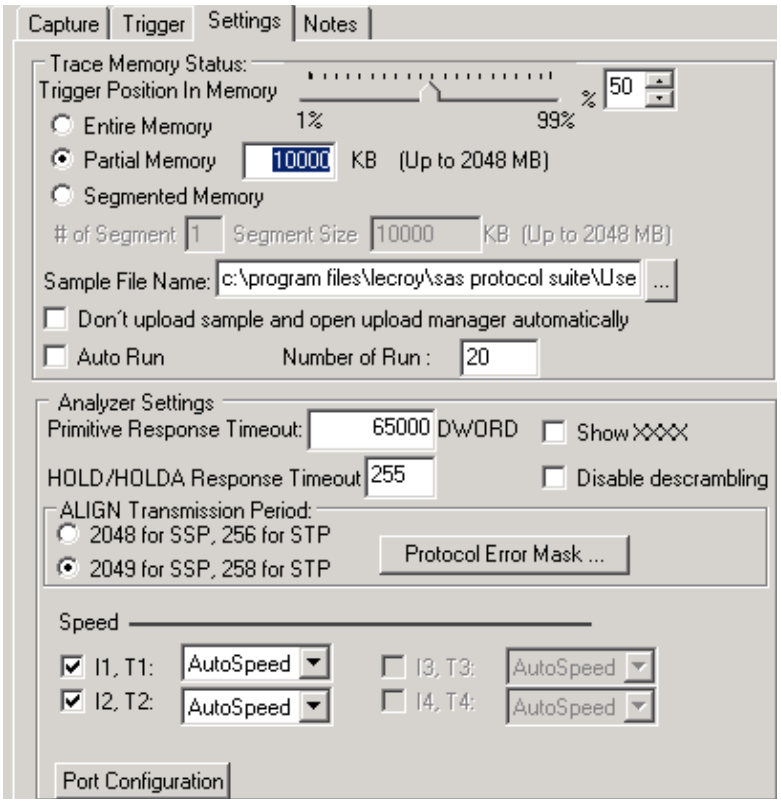


Figure 2.70: SAS: Setting Project Options

SAS vs. SATA: For the ALIGN Transmission Period section, SATA Dialog shows options 256 and 258, and does not show 2048 or 2049.
For Speed, SATA Dialog shows H1, D1 to H2, D2 and does not show I1, T1 to I2, T2.
SATA Dialog does not show MUX Setting button.

SATA dialog shows DevSlp min detection time field to enter the debouncer value.

2.6.18 Memory Settings

The Trace Memory Status section has the following fields.

Trigger Position

Pre-Trigger memory defaults to 50%, which defines the percentage of data to capture before and after the triggering event. You can change this percentage by dragging the slider.

Capture of the specified percentage of the data prior to the triggering event cannot be guaranteed and may be 0. This can occur if the triggering event occurs before storing the required amount of pre-trigger event data. In such a case, the data display shows fewer than the specified data points prior to the triggering event. For more detail, (see "Pre-Trigger" on page 101.)

Note: Trigger Position only works when the triggering option is Pattern.

In certain cases, when one port is recording traffic and filling up the memory much faster than another port, you might see traffic appearing only on one port for a while, and the other port's traffic will only appear later. This occurs as a function of the trigger position, and is normal, expected behavior of the analyzer.

Trace File Name

Click the ellipses next to the Sample File Name text box and choose a file name and location for the results of your current project.

Auto Run

To repeat the current capture and trigger setup automatically, check the Auto Run checkbox and enter the number of times in the Number of Run text box. The capture and trigger repeat automatically for the specified number of times, and the results are saved in consecutively numbered Sample.scs files.

Memory Size

In the Protocol Analyzer Settings tab, you can allot memory for the trace recording. Check **Entire Memory** to allow recording to use the whole memory, to capture the maximum amount of trace data. (Minimum size of memory is 2 GB. Maximum size of memory is 16 GB.)

Partial Memory

To reduce the memory size, check **Partial Memory** and enter a buffer size in kilobytes, up to the memory size in megabytes.

Note: If the size of a data packet exceeds the buffer memory allocation, the project runs, but no data capture occurs. You must increase buffer memory size to a value greater than the packet size.

Segmented Memory

Alternatively, you can use **Segmented Memory**. Enter an integer **# of Segment**, from 1 to 32, then enter an integer **Segment Size** in kilobytes, up to the memory size in megabytes divided by the number of segments. The default segment size is 10 MB.

Each time a trigger condition occurs, the system records a new segment. You can use a Snapshot or Pattern trigger, but not Manual Trigger. As the same trigger automatically repeats, the system makes the number of segments that you entered.

Upload Manager

To upload segments manually in the Upload Manager, select the **Don't upload segments and open upload manager automatically** checkbox.
To upload segments automatically for display as the system creates them, do not select the checkbox.

To view segmented trace files, click the **Upload Manager** button, beside the Record button, to display the Upload Manager dialog (see Figure 2.71 on page 104).

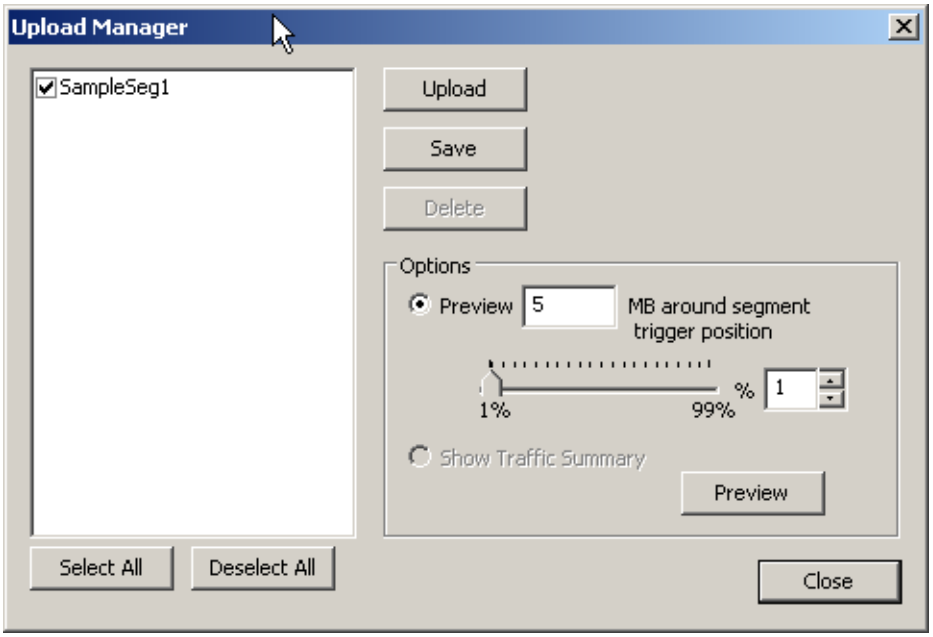


Figure 2.71: Upload Manager Dialog

The dialog displays the segments in the format Segment1, Segment2, and so on.

Select segments by clicking the checkbox. You can also **Select All** or **Deselect All** segments.

You can **Upload** segments for display, **Save** segments as sample files, and **Delete** segments.

The **Preview** radio button allows a preview of an integer number of megabytes around the trigger position. You can set the trigger position as a percentage and select the segment number. Click the radio button to **Show Traffic Summary** with the preview. To show the preview, click the **Preview** button.

2.6.19 Analyzer Settings

Primitive Response Timeout

The Primitive Response Timeout parameter specifies the number of DWORDs between two pair primitives after which the analyzer detects a protocol error. Default value is 65000. When host or device sends a primitive, such as X_RDY, HOLD, or WTRM, it expects device or host to reply with a primitive, such as R_RDY, HOLDA, or R_OK. This parameter detects FIS Signaling Latency error, between HOLD and HOLDA, and FIS State Transition error, between X_RDY and R_RDY, between SOF and EOF, or between WTRM and R_OK or R_ERR.You can set a trigger on these protocol errors.

Disable Descrambling

If checked, causes the Analyzer to assume that no traffic is scrambled. By default, the Analyzer assumes the scrambling state of the devices under test has scrambling enabled.

Show XXXX value

Check this option to display XXXX values.

ALIGN Transmission Period (differs for SAS and SATA)

Choose the ALIGN Transmission Period for SSP and STP by clicking the corresponding option button, then open the Protocol Error Mask dialog.

Power Management Setting (SATA only)

Click the Power Management Setting button to open the Power Management Setting dialog.

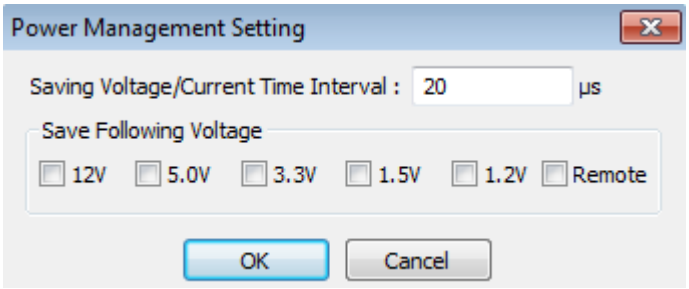


Figure 2.72: Protocol Errors Dialog

Set the Saving Voltage/Current Time Interval duration. Check the applicable Voltage value that you want the Analyzer to save. See “Power Tracker View (SATA only)” on page 247 for more information.

Protocol Error Mask

Click the Protocol Error Mask button to open the Protocol Error Mask dialog.

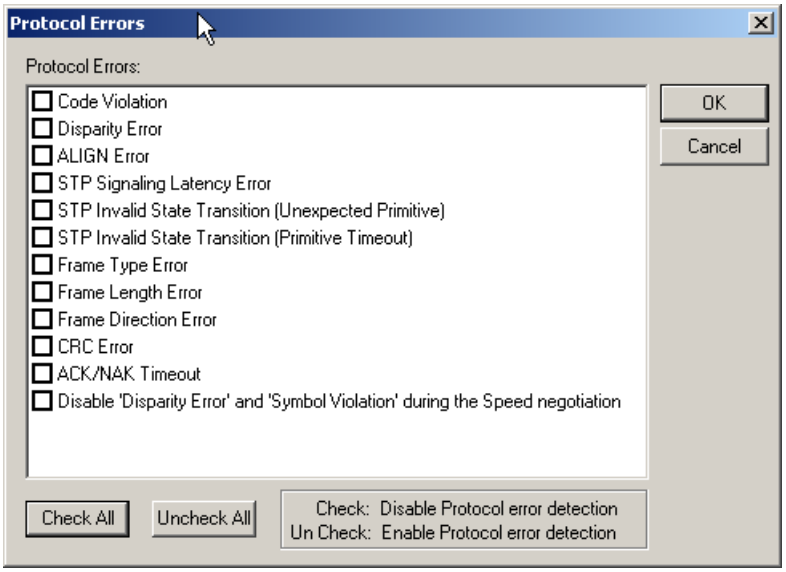


Figure 2.73: Protocol Errors Dialog

Check the Protocol Errors that you want the Analyzer to ignore.

When “RD Error” and “Code violation Error” are set as trigger events:
“RD Error” or “Code violation Error” can occur right after the OOB sequence.
“RD Error” or “Code violation Error” can occur right after the recovery from the PM state.

These errors are mainly caused by the long synchronization time of the analyzer. If these errors, caused by the Analyzer, become triggers, you cannot detect some other errors that you really need to detect. To NOT detect the above two errors, enable the software setting **Disable ‘Disparity Error’ and ‘Symbol Violation’ during Speed negotiation**. After this, the code violation is not triggered during the speed negotiation phase, but is triggered if the violation happens after the speed negotiation phase.

External Trig Out Setting

The Analyzer can send a Low or High external signal when a trigger occurs. Under **Setup** select **External Trig Setting** to choose External Trig Out Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output). Enter the External TrigOut pulse width.

The pulse width is programmable in the software. The Voltage level is 0 to +3.3 Volt. The trigger out is derived by NL17SZ126 buffer. The delay for OOB traffic external trigger out is 330 ns. The delays for non OOB external trigger out are:

- 6G ~ 370 ns
- 3G ~ 540 ns
- 1.5G ~ 850 ns

External Trig In Setting

An external Low or High input signal can cause triggering. Under **Setup** select **External Trig Setting** to choose External Trig In Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Choose Port Speed

The default speed is Autospeed. You can also select the port speed from the drop-down list: 1.5 Gbps, 3.0 Gbps, or 6.0 Gbps.

Note: If a Port ID check box has no check, the analyzer does not capture any patterns for that port. The system allocates trace memory for that port to its adjacent port, for example: I1, T1 <-> I2, T2.

Ports Configuration

Select the **Port Configuration** button to display the Set Port Configuration dialog (see Figure 2.74 on page 107).

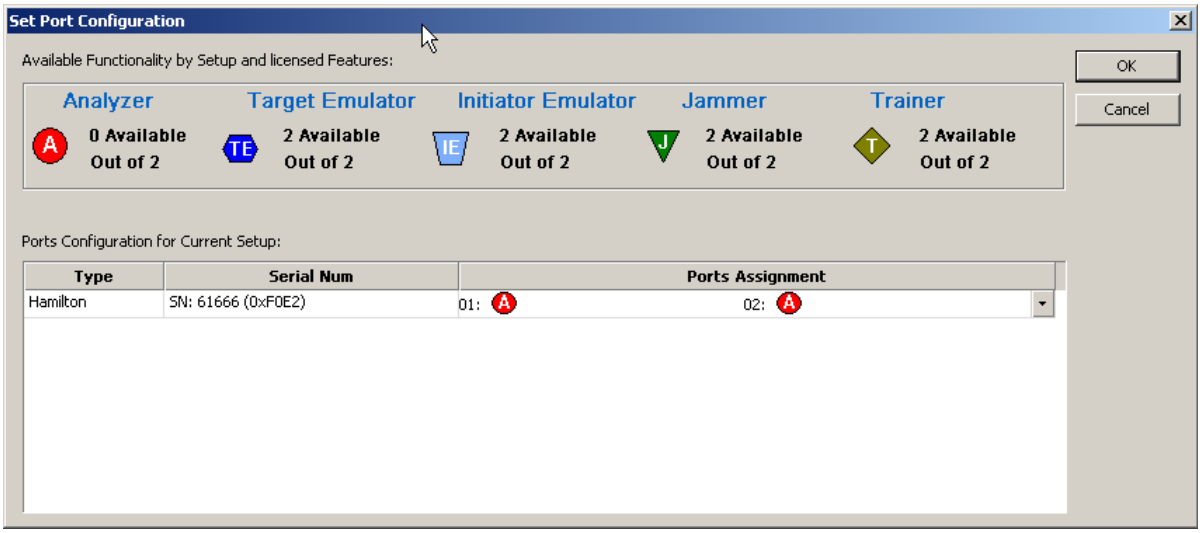


Figure 2.74: SAS: Set Port Configuration Dialog

The dialog shows the current port configuration. To select a port configuration, click the down arrow to display the Select Port Configuration dialog .

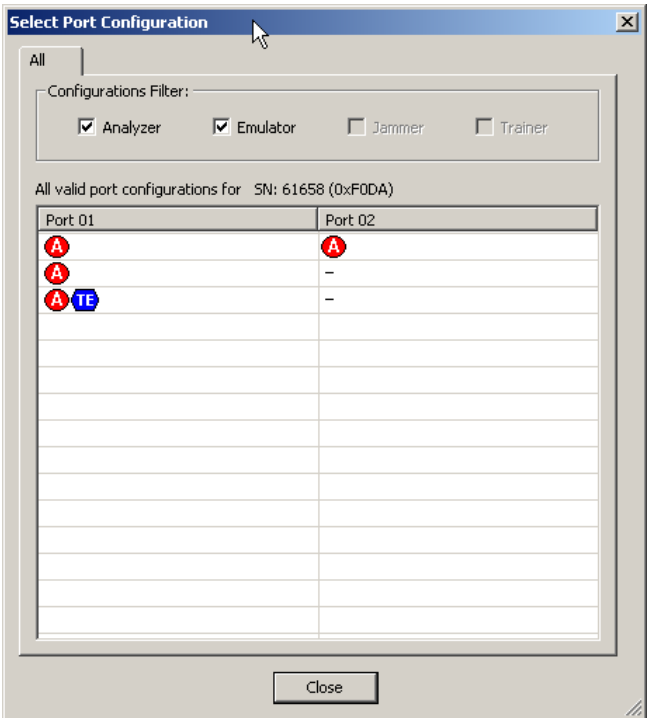


Figure 2.75: SAS: Select Port Configuration Dialog

Port configuration depends on the application you run.

- To act as Analyzer, select the **Analyzer** port configuration.
- To activate a Target Emulator on a port, select the **TargetEmulator** port configuration.

- To activate the Initiator Emulator on a port and run the Analyzer on the same port, select **InitiatorEmulator/Analyzer**.
- To activate the InFusion on a port, select **Jammer**.
- To activate the Trainer on a port, select **Trainer**.

Sierra M6-2 can have Analyzer and Trainer or Analyzer and Jammer on same port.

Note: To display the current Port Configuration, click the green button in the lower right corner to display the Port Status window (see "Port Status" on page 284).

Port Configuration and Projects

Port Configuration depends on Project selected.

Performance Analyzer and Performance Analyzer with Initiator Emulator do not use ports.

Protocol Analyzer, Protocol Analyzer with Initiator Emulator, and Target Emulator can have the following port configurations.

Project	Number	
	One analyzer and/or one emulator	**Two analyzers and/or two emulators**
Protocol Analyzer	Port 1.	One analyzer each on 1 and 2.
Protocol Analyzer with Initiator Emulator	Port 1.	One analyzer each on Port 1 and Port 2.
	Pair on Port 1.	One emulator each on Port 1 and Port 2.
Target Emulator	Port 1.	One emulator each on Port 1 and Port 2.
	Pair on Port 1	

Analyzers work with Emulators, Jammer, and Trainer (see below).

One Initiator Emulator can work by itself or work with one Analyzer.

One Target Emulator can work by itself or work with one Analyzer.

(Note that Host Emulator and Analyzer can be on one port and Analyzer and Device Emulator can be on another port at the same time.)

Emulators do not work with Trainer.

Emulators work with Jammer (see below).

Note: Ports 1 and 2 are a pair. Put related hardware on one pair. For example, put two analyzers on ports 1 and 2.

Jammer can pair with one or two analyzers on a port.
Jammer does not work with Trainer.

Trainer can pair with one analyzer on a port.
Trainer does not work with emulators.

Trainer does not work with Jammer.

MUX Setting (SAS only)

Enable Muxing on port combinations.

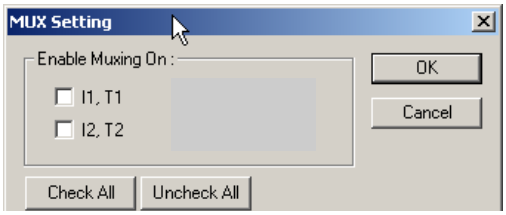


Figure 2.76: MUX Setting Dialog Box

If you enable this option on two ports, the data of both ports transfers on one physical link, whose speed is twice the speed of each link, and the data of two links multiplexes on one physical link. For example, two 3 G ports together make one 6 G port. Note the following (see Figure 2.77 on page 109):

- The muxing check boxes are usable only if two or more emulator channels are selected.
- The initiator emulator check box is greyed out if only one emulator channel is selected.

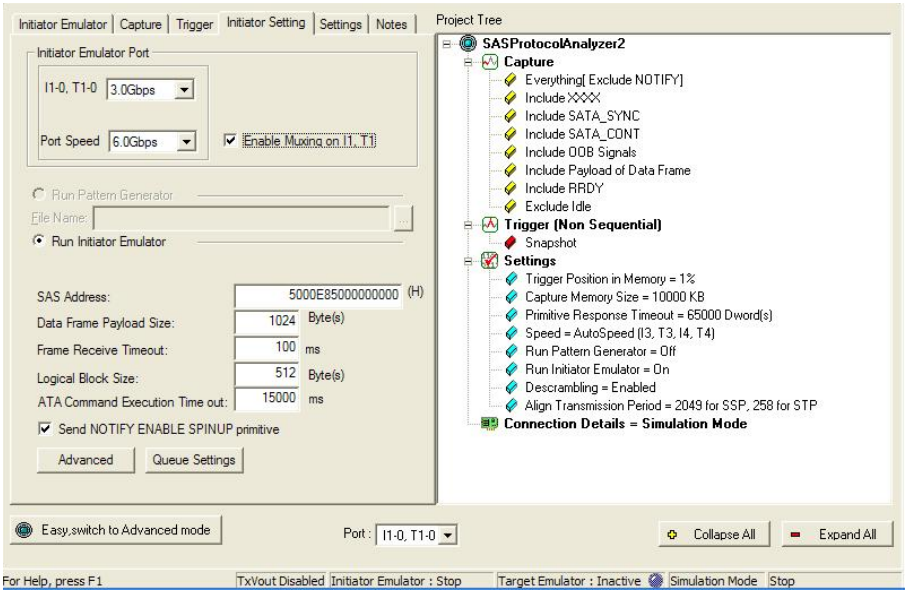


Figure 2.77: Initiator Emulator Check Box and Channel Speeds

- The target emulator check box is not displayed at all until two or more emulator channels are selected.

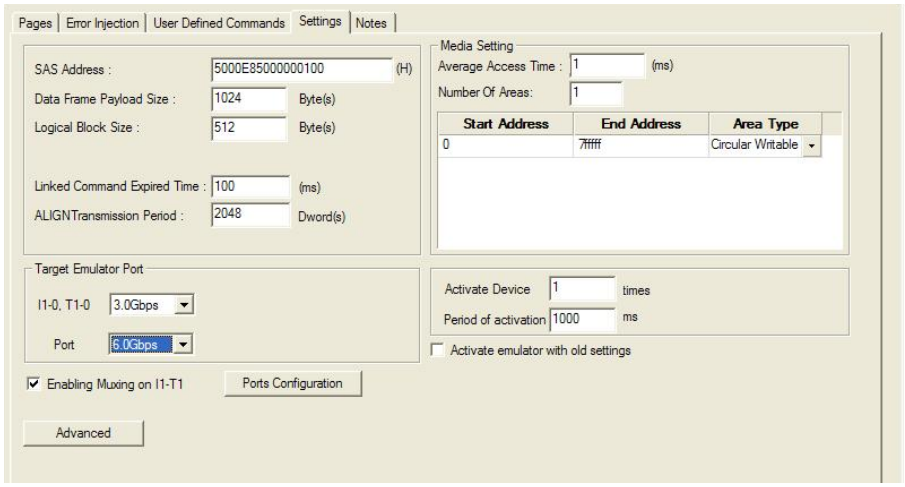


Figure 2.78: Target Emulator Check Box and Channel Speeds

Note: Analyzer must detect MUX primitives from both host and device sides to capture traffic correctly in Muxing mode.

2.6.20 Add a Project Note

To enter and save information about the current project, click the **Notes** tab and enter the data about the project.

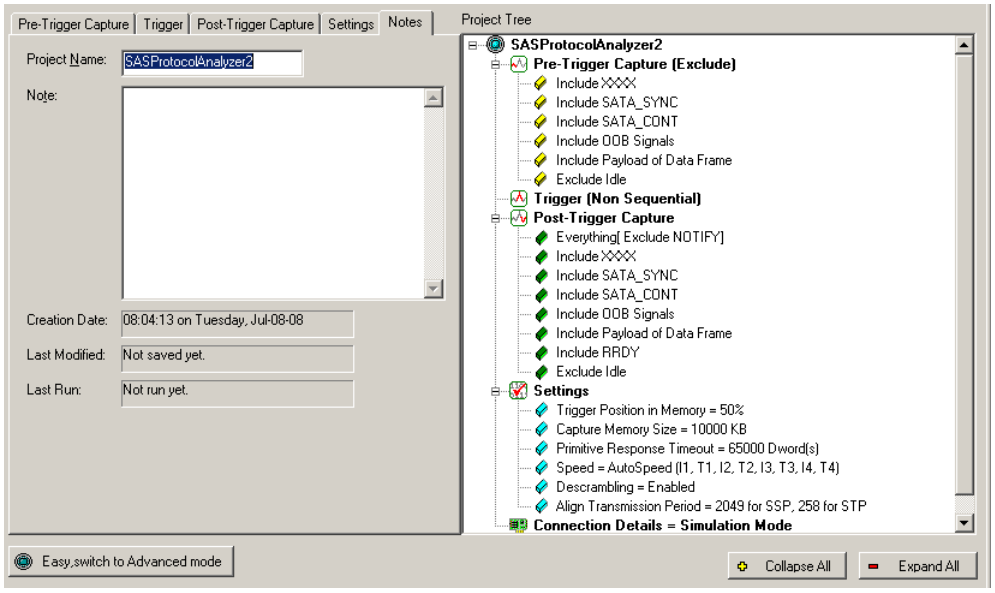


Figure 2.79: Project Notes Tab

2.7 Advanced Mode (User-Defined)

Advanced Mode expands Analysis capability by allowing you to program complex triggering and data capture projects.

The Advanced Mode is a state machine with up to 23 different states. You can program each state individually to:

- Trigger on a different event or trigger unconditionally.
- Capture Everything, Nothing, or a user-defined pattern.
- Include up to three ELSE IF statements, allowing a jump to any other state based on a user definition.
- Use up to three timers, which you can set to a maximum value of 42949 ms. You can set a timer in the state or continue the timer set in the previous state.
- Output an external trigger (High or Low).

Note: In Advanced Mode, events on each link are counted independently. A condition is met if the number of events on a link equals the defined occurrence.

2.7.1 Working in Advanced Mode

To start working in the Advanced Mode, click the **Easy, Switch to Advanced Mode** button in an open Analyzer window.

You can:

- Display the state definition
- Set Output Trigger level
- Select up to three timers
- Define the If condition and up to three Else If conditions
- Set number of occurrences before trigger
- Set captured data
- Set excluded data
- Go to next state
- Add state
- Choose link for Sequencer setup

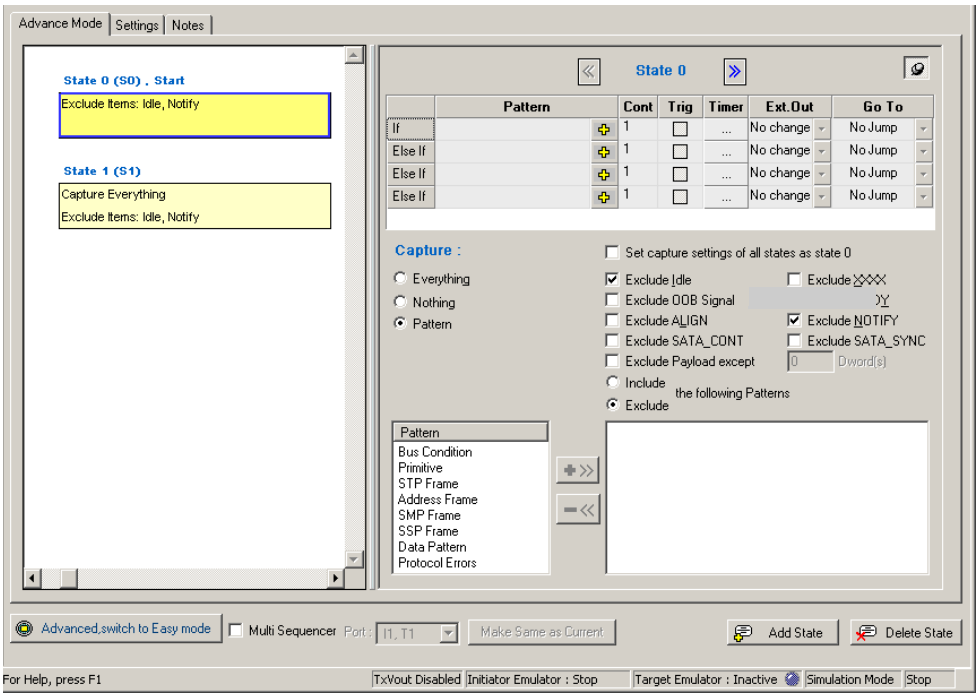


Figure 2.80: SAS: State Programming Dialog

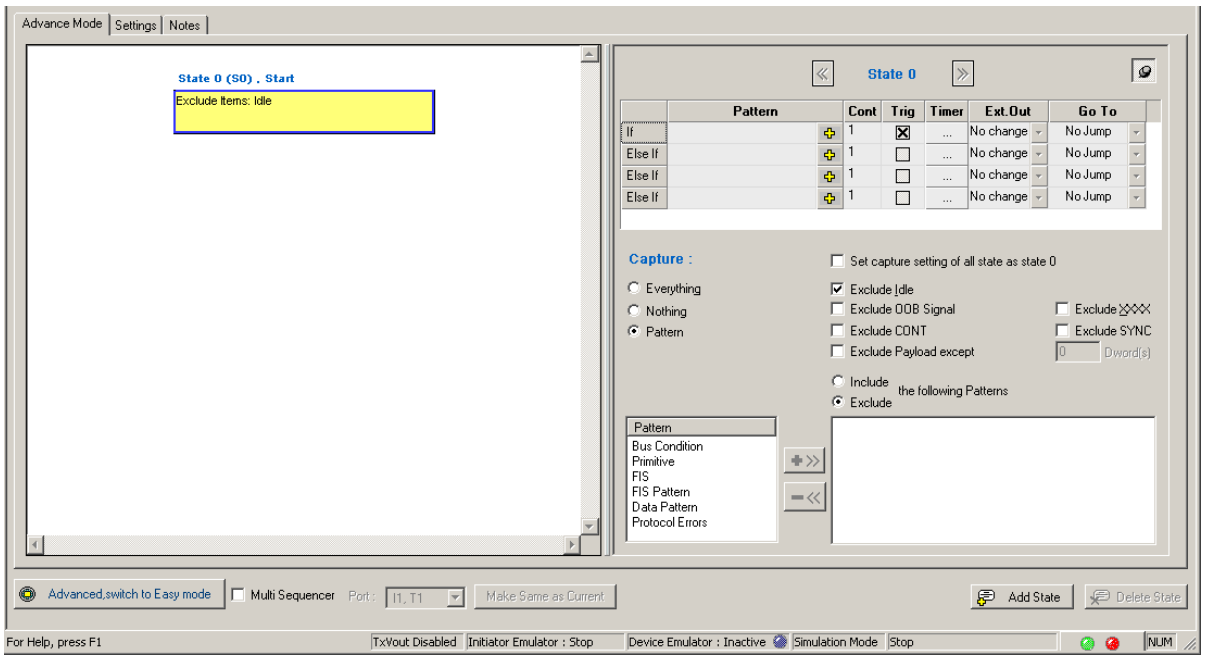


Figure 2.81: SATA: State Programming Dialog

SAS vs. SATA: SATA Dialog removes Exclude ALIGN, Exclude RRDY, and Exclude NOTIFY. SATA Dialog replaces Exclude SATA_CONT with Exclude CONT and Exclude SATA_SYNC with Exclude SYNC.

SATA Dialog has patterns Bus Condition, Primitive, FIS, FIS Pattern, Data Pattern, and Protocol Errors and does not have STP Frame, SMP Frame, STP Frame, or Address Frame.

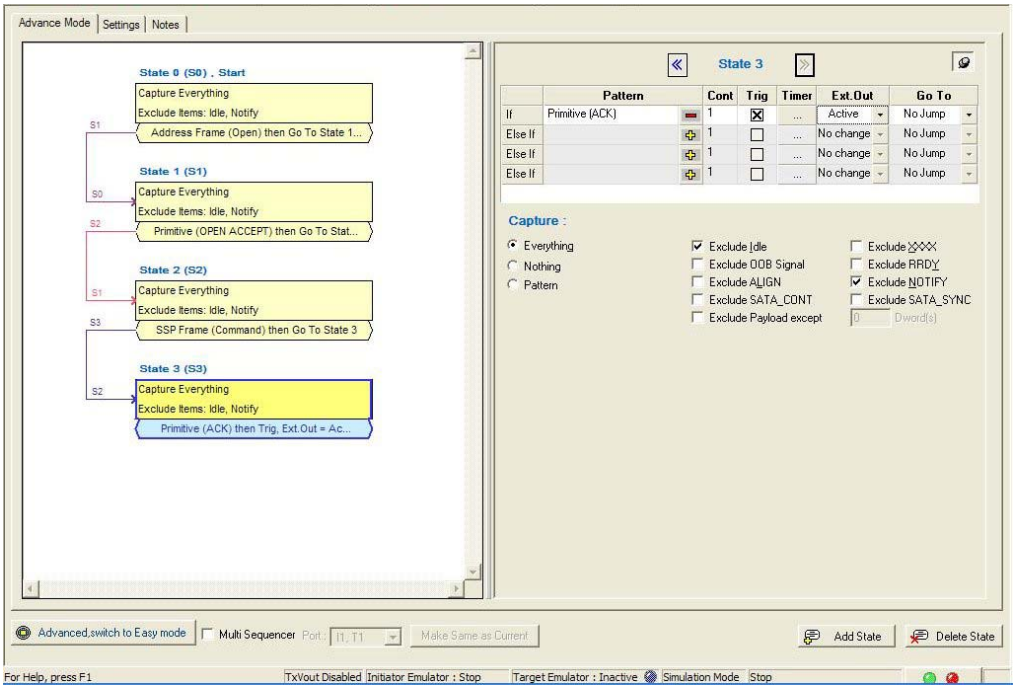


Figure 2.82: SAS: Advanced Trigger with multiple branches

State Number for Complex Trigger Sequences

To follow the path of complex trigger sequences, you can display state numbers in a trace.

To see state number, in Packet View right-click a link layer packet, show field, and select state number.

Setting Trigger Conditions

To set the If and Else If trigger condition:

1. Click the **Add Pattern** button for a Pattern field and choose a trigger condition from the drop-down list (Figure 2.83 on page 114).

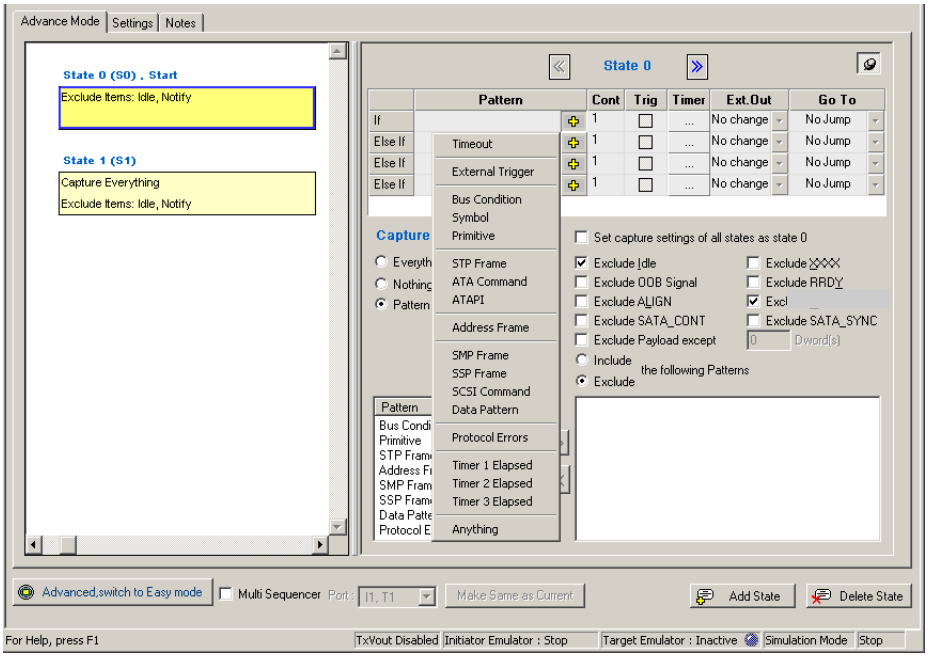


Figure 2.83: SAS: Choosing a Trigger Condition

2. Define each selected pattern in the same way as in Easy Mode, as described starting on page 66. To use a timer, define it first.

Note: You can set a timer for any If or Else If condition.

3. Enter a value for the number of occurrences before trigger in the **Cont** field, up to a maximum of 65535 occurrences.
4. Choose a capture option: **Everything, Nothing,** or **Pattern**.
5. If you choose Pattern, you can select patterns for inclusion or exclusion. Clicking the **Pattern** option enables a pattern definition dialog (see Figure 2.84 on page 114).

Figure 2.84: SAS: Choosing a Pattern

6. Choose pattern(s) and click the **+>>** button to add them for capture or exclusion. You define each pattern the same way as in Easy mode (see "Defining Patterns" on page 66).
7. For an output trigger, click the down arrow in the **Ext. Out** field and choose an output trigger level. **Note:** Do not use the LOW setting in Advanced Mode.
8. To go to another state, click the down arrow in the **Go To** field and select a state. If no other state has been defined, choose **New State** to add a state.

2.7.2 Multi-Link Triggering

You can set different triggering for each link. To set different trigger conditions for a link, check the **Multi Sequencer** check box and select the link for setup from the Port drop-down list.

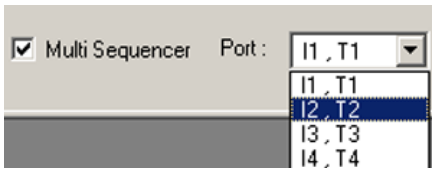


Figure 2.85: Multi-Link Triggering Setup

2.7.3 Set Timers

You can set and use up to three timers for triggering. You can set each timer for each state or continue from a timer set in the previous state. The timer defined for a particular state starts when entering that state. To set timers, click the **ellipses** in the **Timer** field in each state and define each of the timers in the Set Timers dialog.

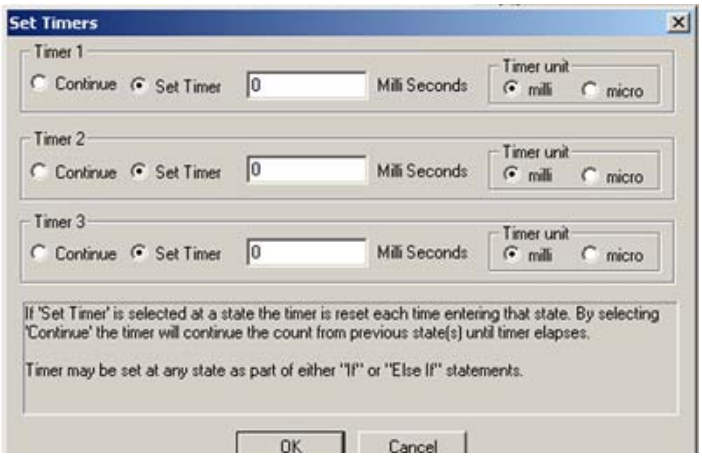


Figure 2.86: Set Timers Dialog

Note: Three timers are available. You have to set and start each timer in order to continue the next timer. For example, you have to start Timer 1, continue it, then set Timer 2 in order to continue it. It will not allow you to continue Timer 2 until you first set it.

2.7.4 Timeout

The timeout trigger allows triggering based on the occurrence or non-occurrence of two events within a pre-defined period of time. Patterns can be added to the Start Events and End Events list. An occurrence of a pattern of the Start Events list starts the timer, or resets the timer if the timer is already running. Depending on the configurable Trigger mode, the trigger is activated when the End Event(s) occur before the timer expires, or the timer expires before the End Event(s) occurs.

- You can set a Timeout.
- Select a Pattern for the Start Event. (Start Event resets the timer.)

- Select a Pattern for the End Event.
- Enter the Timeout Value in milliseconds or microseconds.
- Select a Trigger Mode:
  - If End Event occurs before timer expires.
  - If timer expires before End Event occurs.

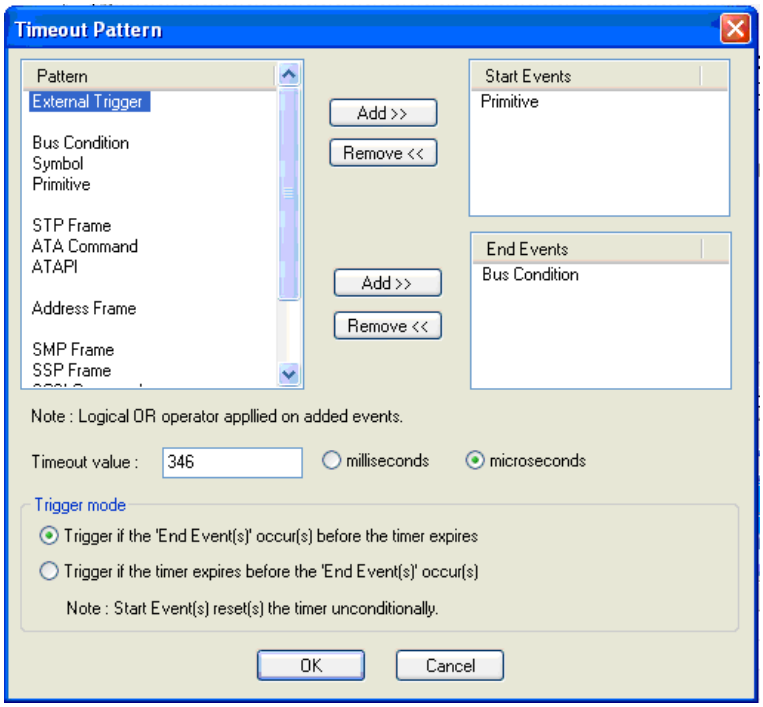


Figure 2.87: Timeout Dialog

WARNING: In Advanced Mode, Short State Jump Intervals Can Cause Hardware Queue Overflow and Corrupt Frames.

When using Advanced Mode, if too many state jumps occur in a short time, the hardware queue can overflow, which may corrupt frames. For example, an infinite loop can cause many state jumps in a short time. Hardware overflow can occur if interval between state jumps is less than 60 DWORDs.

In Advanced Mode, infinite loops are usually used to check if an event occurs before a timeout. In this case, you can use the Timeout dialog to avoid hardware queue overflow.

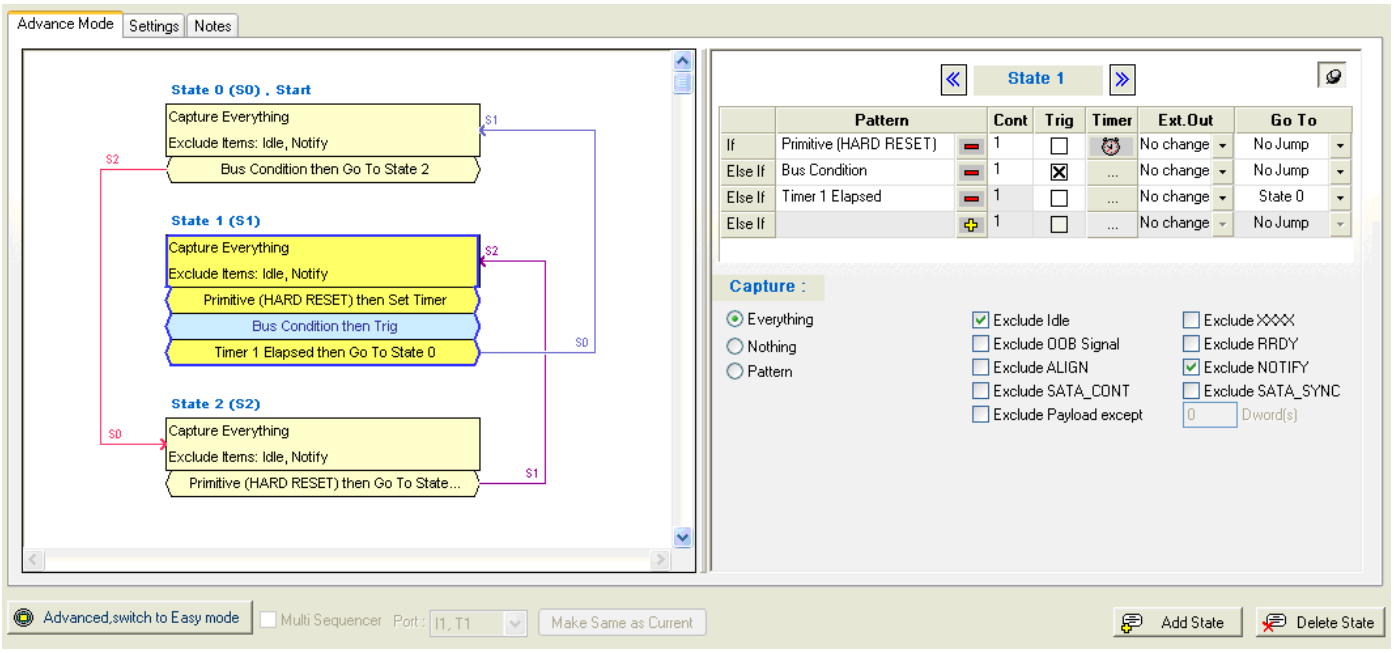


Figure 2.88: State Machine with Multiple Patterns and Timer Elapse

In Figure 2.88: , the port detects HARD_RESET, which starts the Timer. When the timer expires, it jumps to another state. If a trigger occurs between timer start and end, the captured trace will have corrupt frames because of hardware queue overflow.

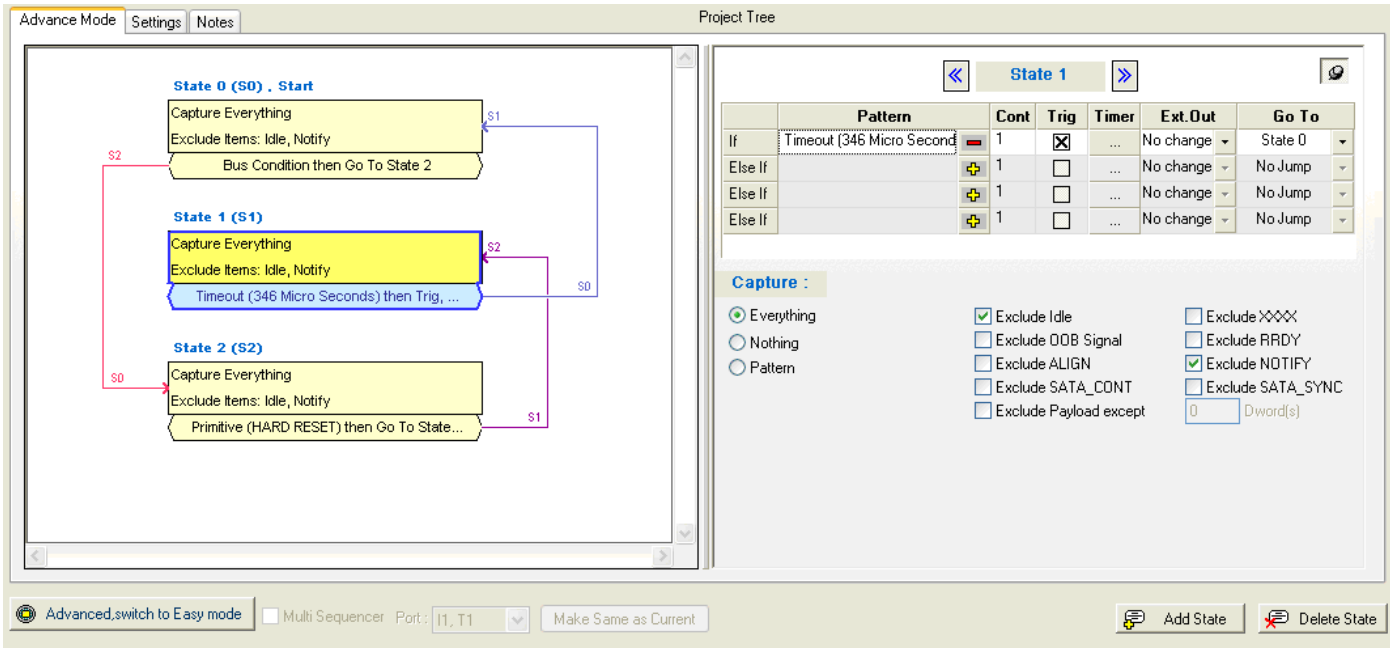


Figure 2.89: State Machine with Timeout Pattern to replace Timer

To overcome this limitation, use a Timeout Pattern instead of Timer. Figure 2.89 shows the state machine using Timeout instead of Timer.

Figure 2.90 on page 118 shows the Timeout settings.

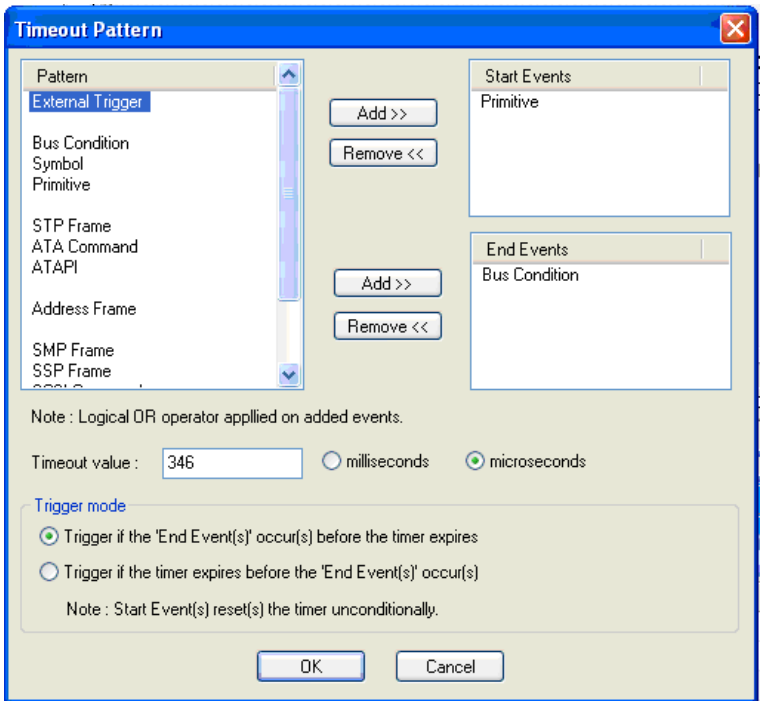


Figure 2.90: Timeout Settings

Timeout begins when the port detects the Start Event. Timer begins when the port detects the Hard RESET primitive. In the Trigger Mode window, set the Trigger to trigger when the port detects the End Event, before the Timeout occurs. In our example, this is the Bus Condition. Capture begins when the ports detects the Bus Condition before the Timeout occurs. If the port does not detect the Bus Condition until the Timeout occurs, the State Machine in Figure 2.89 on page 117 jumps to State 0.

Useful Key Sequences

The following key sequences are active to assist you in navigating a defined state machine:

Ctrl+a	Add State
Insert	Insert State
Del	Delete State
Ctrl+c/Ctrl+Ins	Copy
Ctrl+v/Shift+Ins	Paste
Up/Down arrow keys	Moves selection between states
Page Up/Page Down	Page Up and Page Down states
Home	Go to first page
End	Go to end page

2.8 Project Settings

Prior to running the Advanced mode project, click the **Settings** tab. The options in the Settings dialog are the same as for the Easy Mode, described starting on **page 101**.

SAS vs. SATA: For the ALIGN Transmission Period section, SATA Dialog shows options 256 and 258, and does not show 2048 or 2049.
For Speed, SATA Dialog shows H1, D1 to H2, D2 and does not show I1, T1 to I2, T2.
SATA Dialog does not show MUX Setting button.

2.8.1 Notes

To include some descriptive information about the project, click the **Notes** tab and enter a brief descriptive note (see “Add a Project Note” on page 110).

2.9 Emulation

SAS: To perform a capture with SAS Initiator Emulator generated bus traffic, click **File > New > Protocol Analyzer (Initiator Emulator)**.

SATA: To perform a capture with SATA Host Emulator generated bus traffic, click **File > New > Protocol Analyzer (Host Emulator)**.

Program the Initiator Emulator or Host Emulator, then set up a capture, as described in “Protocol Analysis” on page 47.

2.9.1 Programming the Initiator or Host Emulator

SAS: Click the **Initiator Emulator** tab.

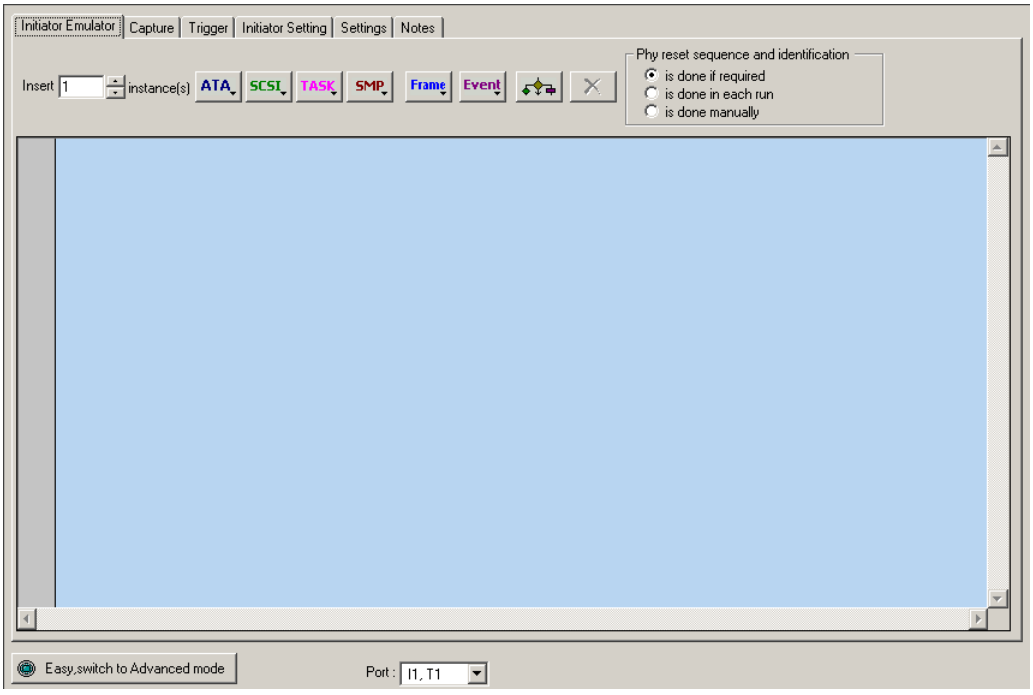


Figure 2.91: SAS: Initiator Emulator Program Dialog

SATA: Click the **Host Emulator** tab.

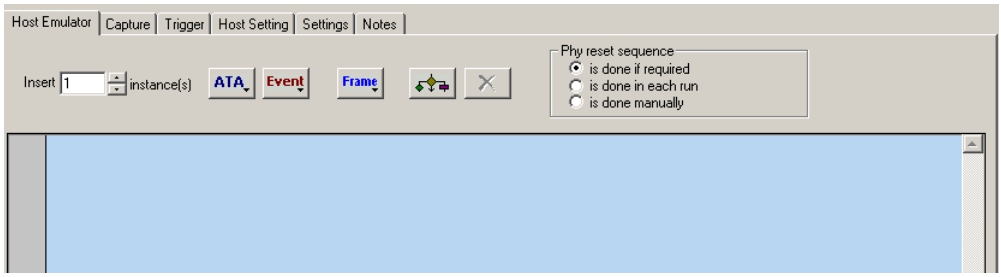


Figure 2.92: SATA: Host Emulator Program Dialog

SAS vs. SATA: SATA Dialog removes the SCSI, Task, and SMP buttons and replaces the Initiator Setting tab with the Host Setting tab.

SAS: You can create an Initiator program using ATA, SCSI, Task, and SMP commands; Frames; and/or Events. These commands can execute in a program loop or be subject to user-specified conditions.

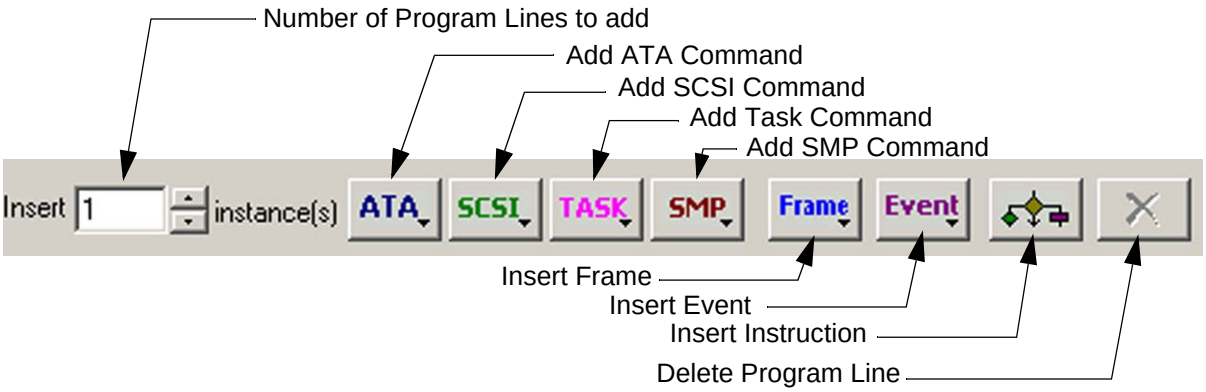


Figure 2.93: SAS: Host Emulator Program Dialog

SATA: You can create a Host program using ATA, Frames, and/or Events.

Add Program Lines

To add program lines, enter the number of lines to add in the Insert field, then click a command button: ATA, SCSI, TASK, SMP, Frame, or Event.

Note: SAS Initiator Emulator supports a queue depth of 32 commands.

2.9.2 Adding Initiator or Host Emulator Commands

Adding an ATA Command

Click the **Insert ATA Command** button, click one of the command categories, and choose a command (see Figure 2.94 on page 121).

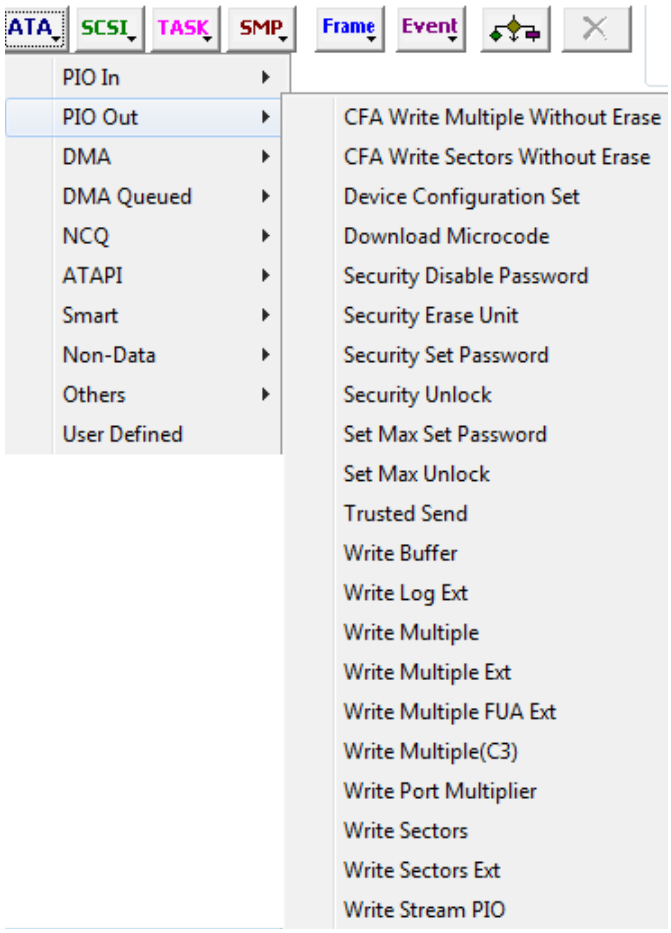


Figure 2.94: ATA Dropdown List

The following menu options are available:

- PIO In
- PIO Out
- DMA
- DMA Queued
- NCQ
- ATAPI
- Smart (see below)
- Non-Data
- Others
- User Defined

Smart Commands (SATA only)

To enable smart commands, click the **Settings** tab to open the Settings dialog, click the **Advanced** button to open the Advanced Target Setting dialog, go to the Miscellaneous Feature tab, check **Support smart feature set**, and check the specific features to enable them (see "Miscellaneous Features Tab" on page 204).

Note about Payload Data file: The software refreshes the Payload Data file automatically, so when you select a Payload Data file, you get the latest version.
For the SPC4 SEND DIAGNOSTIC command, if you have selected the non-default path to the development directory on the Software Settings page, that path is shown when you select a Payload Data file.

Adding a User-Defined ATA Command

Click the **Insert ATA Command** button and choose **User Defined**. This enters an ATA command line with editable fields to define your own custom command.

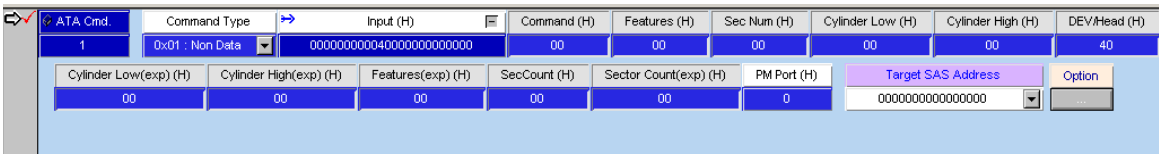


Figure 2.95: Insert ATA Command

Adding a SCSI Command (SAS only)

Click the **Insert SCSI Command** button, click one of the command categories, and choose a command (see Figure 2.96 on page 123).

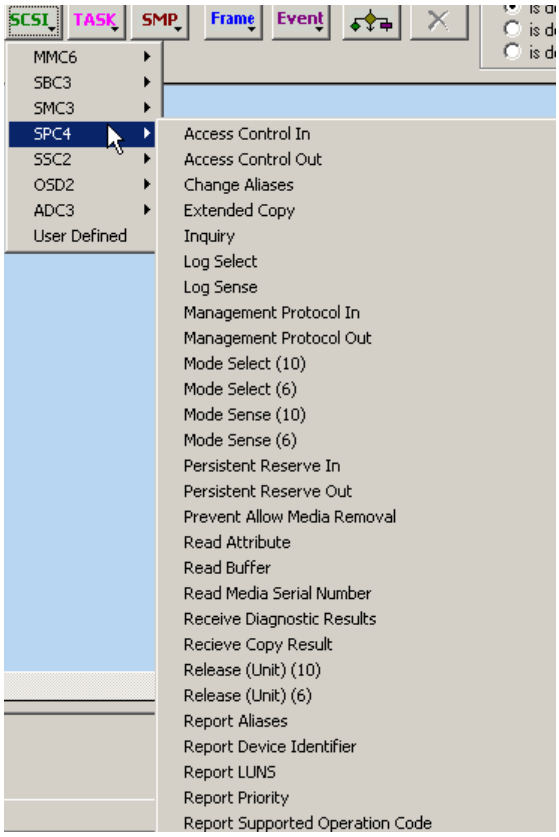


Figure 2.96: SAS: SCSI Dropdown List

The following menu options are available:

- MMC6
- SBC3
- SMC3
- SPC4
- SSC2
- OSD2
- ADC3
- User Defined

Adding a User-Defined SCSI Command (SAS only)

Click the **Insert SCSI Command** button and choose **User Defined**. This enters an SCSI command line with editable fields to define your own custom command.

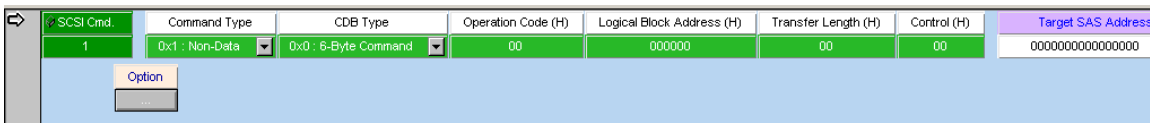


Figure 2.97: Insert SCSI Command

User-defined SCSI commands are Non-Data, Read from Block Device, Read from Non-Block Device, Write to Block Device, Write to Non-Block Device, Bi-Directional from Block, Skip_Write, and Skip_Read.

Adding a TASK Command (SAS only)

Click the **Insert Task Command** button and choose the command to insert.

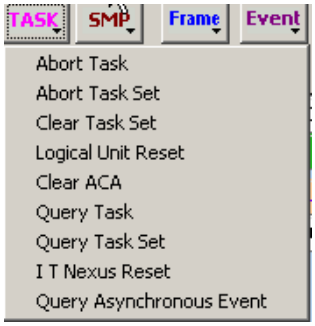


Figure 2.98: SAS: TASK Dropdown List

The following menu options are available:

- Abort Task
- Abort Task Set
- Clear Task Set
- Logical Unit Reset
- Clear ACA
- Query Task
- Query Task Set
- I T Nexus Reset
- Query Asynchronous Event

Adding an SMP Command (SAS only)

Click the **Insert SMP Command** button and choose the command to insert.

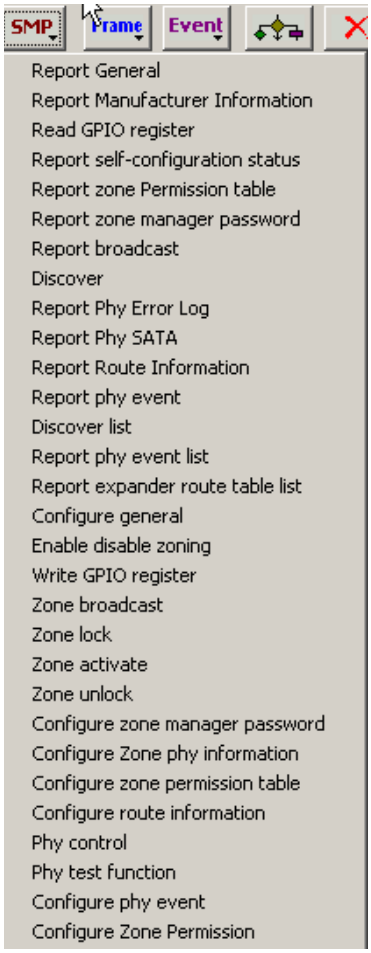


Figure 2.99: SAS: SMP Dropdown List

The following menu options are available:

- Report General
- Report Manufacturer Information
- Read GPIO Register
- Report self-configuration status
- Report zone permission table
- Report zone manager password
- Report broadcast
- Discover
- Report Phy Error Log
- Report Phy SATA
- Report Route Information
- Report phy event
- Discover list
- Report phy event list
- Report expander route table list

- Configure general
- Enable disable zoning
- Write GPIO register
- Zone broadcast
- Zone lock
- Zone activate
- Zone unlock
- Configure zone manager password
- Configure zone phy information
- Configure zone permission table
- Configure route information
- Phy control
- Phy test function
- Configure phy event
- Configure Zone Permission

Adding a Frame

SAS: Click the **Insert Frame** button and choose the frame type to insert.

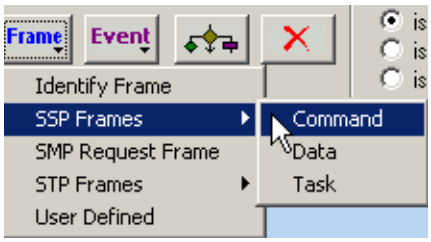


Figure 2.100: SAS: Frame Dropdown List

Note: SSP and STP frames offer additional options.

The following menu options are available:

- Identify Frame
- SSP Frames (Command, Data, Task)
- SMP Request Frame
- STP FRames (Host to Device, DMA Setup, Data)
- User Defined

SATA: Click the **Insert Frame** button and choose the frame type to insert.

Figure 2.101: SATA: Frame Dropdown List

The following menu options are available:

- Self Test
- Host to Device
- DMA Setup
- Data
- User Defined

Adding an Event

Click the **Insert Event** button and choose the event to insert.

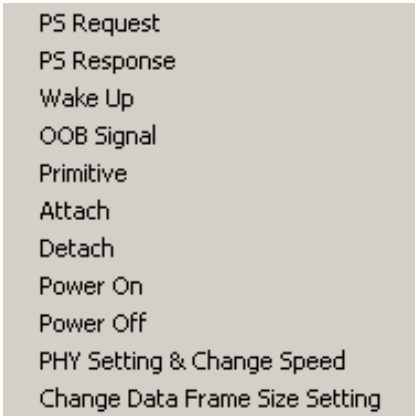


Figure 2.102: SAS: Event Dropdown List

The following menu options are available:

- PS Request
- PS Response
- Wake Up
- OOB Signal
- Primitive
- Attach
- Detach
- Power On (see “Power On” on page 128)
- Power Off
- PHY Setting & Change Speed
- Change Data Frame Size Setting

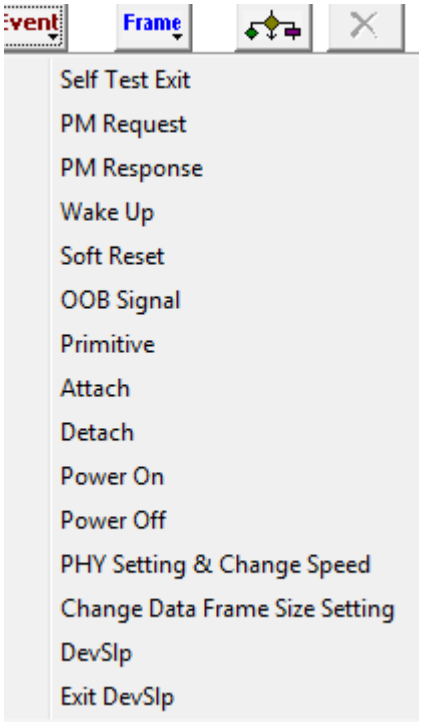


Figure 2.103: SATA: Event Dropdown List

The following menu options are available for SATA events:

- Self Test Exit
- PM Request
- PM Response
- Wake Up
- Soft Reset
- OOB Signal
- Primitive
- Attach
- Detach
- Power On (see “Power On” on page 128)
- Power Off
- PHY Setting & Change Speed
- Change Data Frame Size Setting
- DevSlp- Toggles pin 3 of the power segment of the of the SATA connector to high setting.
- Exit DevSlp- Toggles pin 3 of the power segment of the of the SATA connector to low setting.

Power On

The Power Sources command supports 1.2, 1.5, 3.3, 5.0 and 12 Volts electricity voltage. Click the **...** button to display the Power Sources dialog (see Figure 2.104 on page 129.

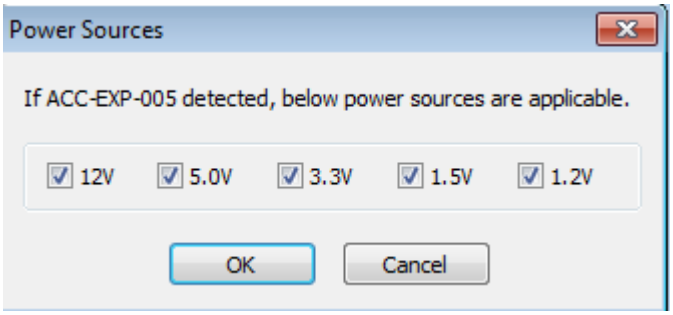


Figure 2.104: SAS/SATA: Power Sources Dialog

PHY Setting Dialog

Sierra M6-4 and Sierra M6-2 only: The PHY Setting & Change Speed command supports 1.5, 3, and 6 Gbps speed changing. You can run commands for different speeds, which is especially useful for device checking. The Analyzer should support the Auto-Speed mode. Click the **...** button to display the PHY Setting dialog.

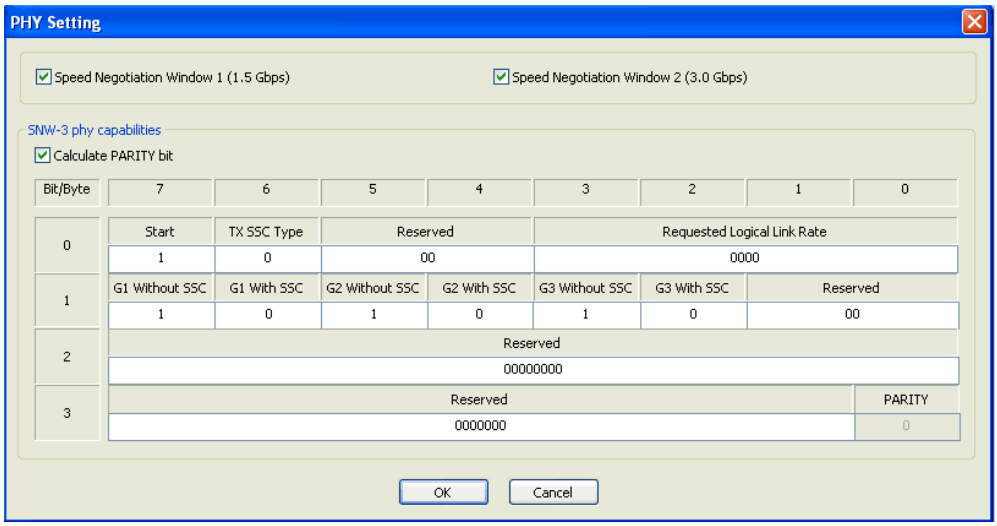

PHY Setting
Speed Negotiation Window 1 (1.5 Gbps)
Speed Negotiation Window 2 (3.0 Gbps)
SNW-3 phy capabilities
Calculate PARITY bit
Bit/Byte 7 6 5 4 3 2 1 0
0 Start TX SSC Type Reserved Requested Logical Link Rate
1 0 00 0000
1 G1 Without SSC G1 With SSC G2 Without SSC G2 With SSC G3 Without SSC G3 With SSC Reserved
1 0 1 0 1 0 00
2 Reserved
00000000
3 Reserved PARITY
0000000 0
OK
Cancel

Figure 2.105: SAS: PHY Setting Dialog

Select **Speed Negotiation Window 1 (1.5 Gbps)** or **2 (3 Gbps)**.

For SNW-3 PHY Capabilities, you can select **Calculate PARITY bit** or not.

For Line 0, enter Start, TX SSC Type, and/or Requested Logical Link Rate.

For Line 1, enter G1 without SSC, G1 with SSC, G2 without SSC, G2 with SSC, G3 without SSC, and G3 with SSC.

Inserting Instructions

Instructions are logical program elements that allow the definition of how the Initiator Emulator program executes. Using instructions, you can define program loops, make conditional jumps, and insert delays and stops.

To insert an instruction, click a command in the Initiator Emulator program where you want the instruction inserted, then click the **Insert Instruction** button, then choose the instruction to insert.

Figure 2.106: Insert Instructions Dropdown List

Start Loop

Click the command at which to start the loop, and then insert the Loop Start instruction.

Figure 2.107: Start Loop

Loop Count

Enter the number of times to run the loop in the number text box, or click the down arrow on the Count Drop-down combo box and choose Infinite.

End Loop

Click the command at which to stop the loop, and then insert the Loop End instruction.

Figure 2.108: End Loop

Add a Goto

To insert an unconditional jump to a previously labeled command, insert a Goto instruction. Then click the down arrow on the Drop-down combo box and choose the label to designate the destination command.

Figure 2.109: Goto

Add an If

To insert a conditional jump to a previously labeled command, insert an If instruction. Choose a specialized condition for the If from the If flyout.

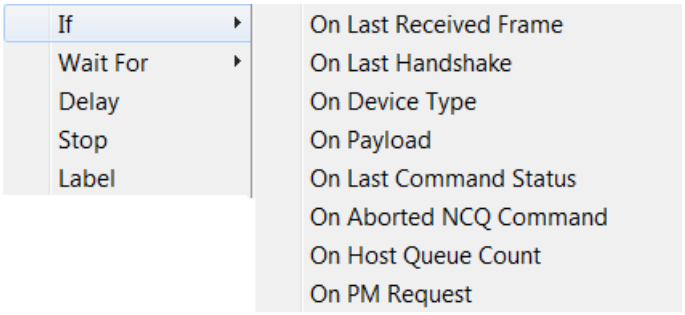


Figure 2.110: If

Then click the down arrow on the If Drop-down combo box, choose the condition for the jump and then the down arrow on the Goto Drop-down combo box, and choose the label to designate the destination of the jump.

Figure 2.111: If on Payload

For commands with incoming payloads, you can specify patterns for a condition by clicking the options button on a payload instruction and defining pattern(s).

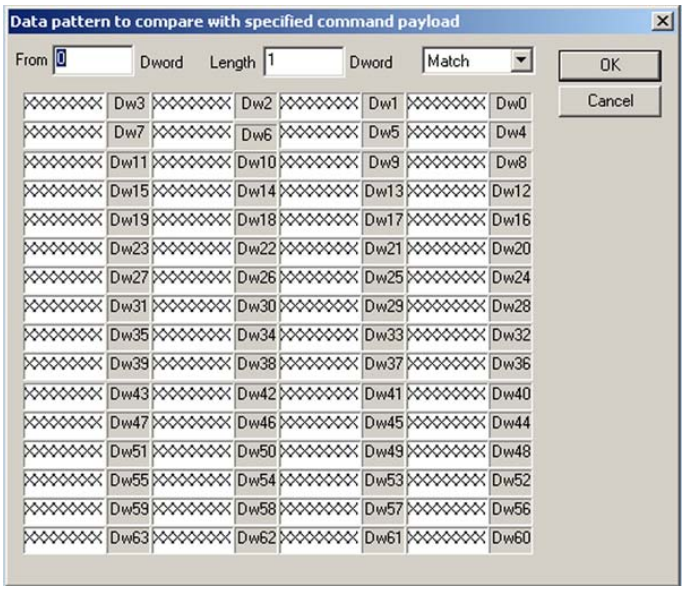


Figure 2.112: Specify Patterns

Add Wait for Any Frame

Insert this instruction and set an expiration time and a label for the Goto. This instruction causes the Initiator program to go to the specified label if any frame occurs prior to the expiration time. If the expiration time occurs first, the Initiator program goes to the next step.

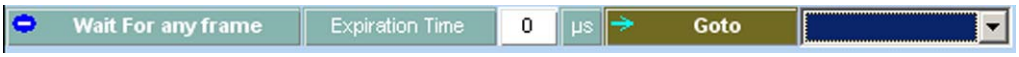


Figure 2.113: Wait

Add Wait for PS (SAS only)

Insert this instruction and select PS_ACK or PS_NAK. Set an expiration time and a label for the Goto. This instruction causes the emulator to go to the specified label if any frame occurs prior to the expiration time. If the expiration time occurs first, the emulator goes to the next step.

Figure 2.114: SAS: Wait for PS

Add Wait for Power Management (SATA only)

Insert this instruction and select PM_ACK or PM_NAK. Set an expiration time and a label for the Goto. This instruction causes the emulator to go to the specified label if any frame occurs prior to the expiration time. If the expiration time occurs first, the emulator goes to the next step.

Figure 2.115: SATA: Wait for Power Management

Insert Delay

To delay program execution, insert a Delay instruction. Enter the delay value (in microseconds) in the number text box to define a delay.

Figure 2.116: Delay

Add Stop

To define the end of the Initiator Emulator program, insert the Stop Initiator Exerciser instruction.

Figure 2.117: Stop

Add a Label

Add a label to any command, to use for conditional and unconditional jumps. Click the command to label, and insert the Label instruction. You can also insert a label by right-clicking a command and choosing Add Label.

Figure 2.118: Label

Labels are automatically labeled as Label# sequentially as they are added. However, you can assign them meaningful names such as STOP and START.

Instruction insert

You can set the instruction to insert before or after a command by setting the insertion mode. To set the insertion mode, right-click in the initiator page and choose Insert before current position or Insert after current position.

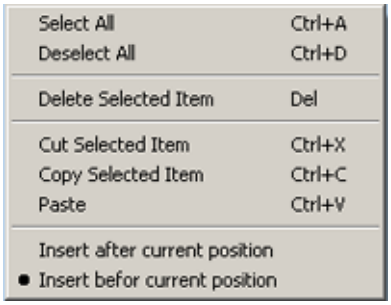


Figure 2.119: Instruction Insert

Phy Reset Sequence and Identification

The system performs this when required, by default, but you can perform it manually or on each run.

Sample Host Emulator Program (SATA only)

Figure 2.120 shows a simple completed SATA Host Emulator program.

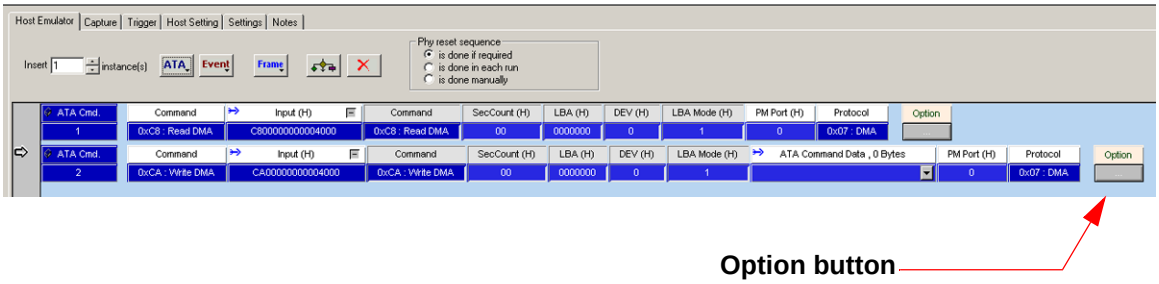


Figure 2.120: SATA: Sample Host Emulator Program

Sample Initiator Emulator Program (SAS only)

Figure 2.121 shows a simple completed SAS Initiator Emulator program.

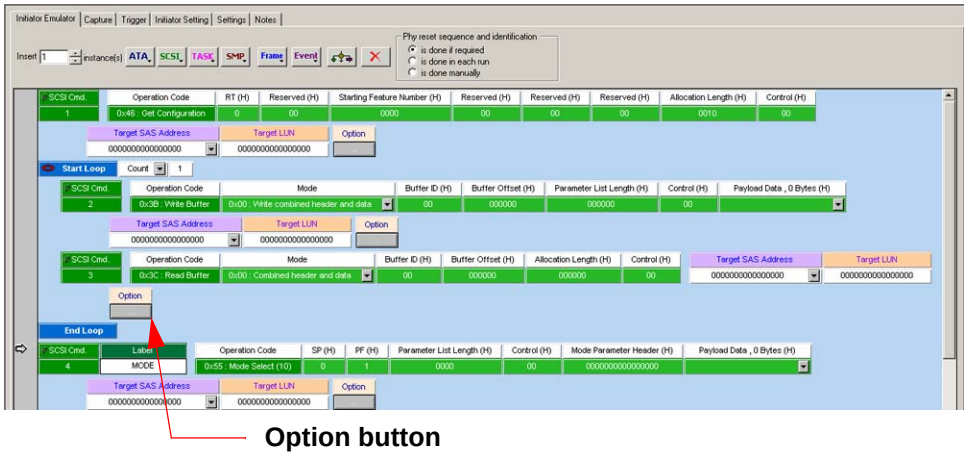


Figure 2.121: SAS: Sample Initiator Emulator Program

Data Blocks

For commands requiring data blocks, click the down arrow of the **Payload Data** drop-down combo box and choose from a set of pre-defined data blocks. If you need a new data block, select **Setup > Data Block** or click the **Data Block** icon on the tool bar to open a data block definition dialog (see "Creating a Data Block" on page 161 for instructions on creating data blocks).

Exercising Specific Addresses

Since more than one device can be active at any given time, you can specify specific commands to send to an address. To assign commands to an address:

1. Click the down arrow on a **Target SAS Address** block in a completed Initiator Emulator program, then choose **Find New Device**.

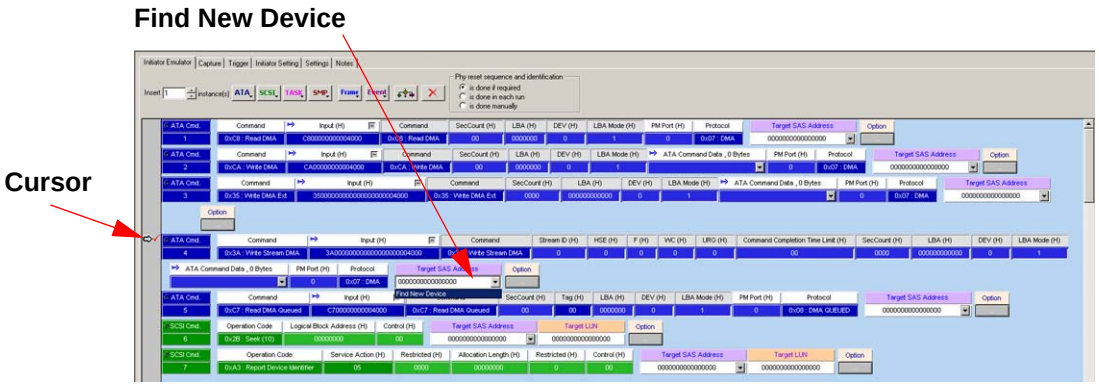


Figure 2.122: SAS: Find SAS Devices Select

Choosing **Find New Device** opens the Device Identifier dialog.

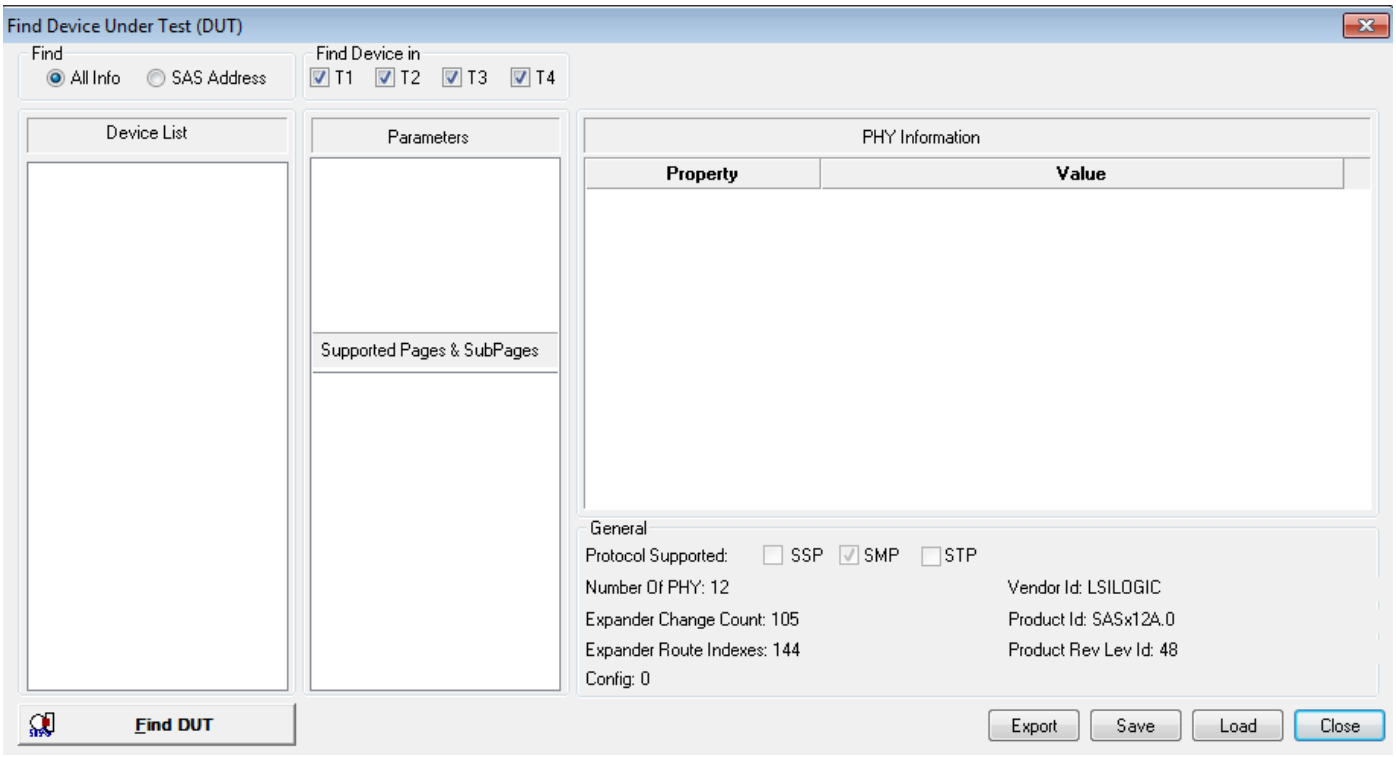


Figure 2.123: SAS: Device Identifier Dialog

SAS vs. SATA: SATA Dialog does not show Find section (All Info and SAS Address).
SATA Dialog has devices D1 to D2 and does not show T1 to T2.
SATA Dialog does not show Supported Pages and Subpages.
SATA dialog lists Word, Description and Value, not Offset, Field, Length, and Value.
SATA dialog lists Device Type, Serial Number, and Spec Version, not Protocol Supported (SSP, SMP, STP)

2. Click the **Find DUT** button to display all active addresses (see Figure 2.124 on page 136).

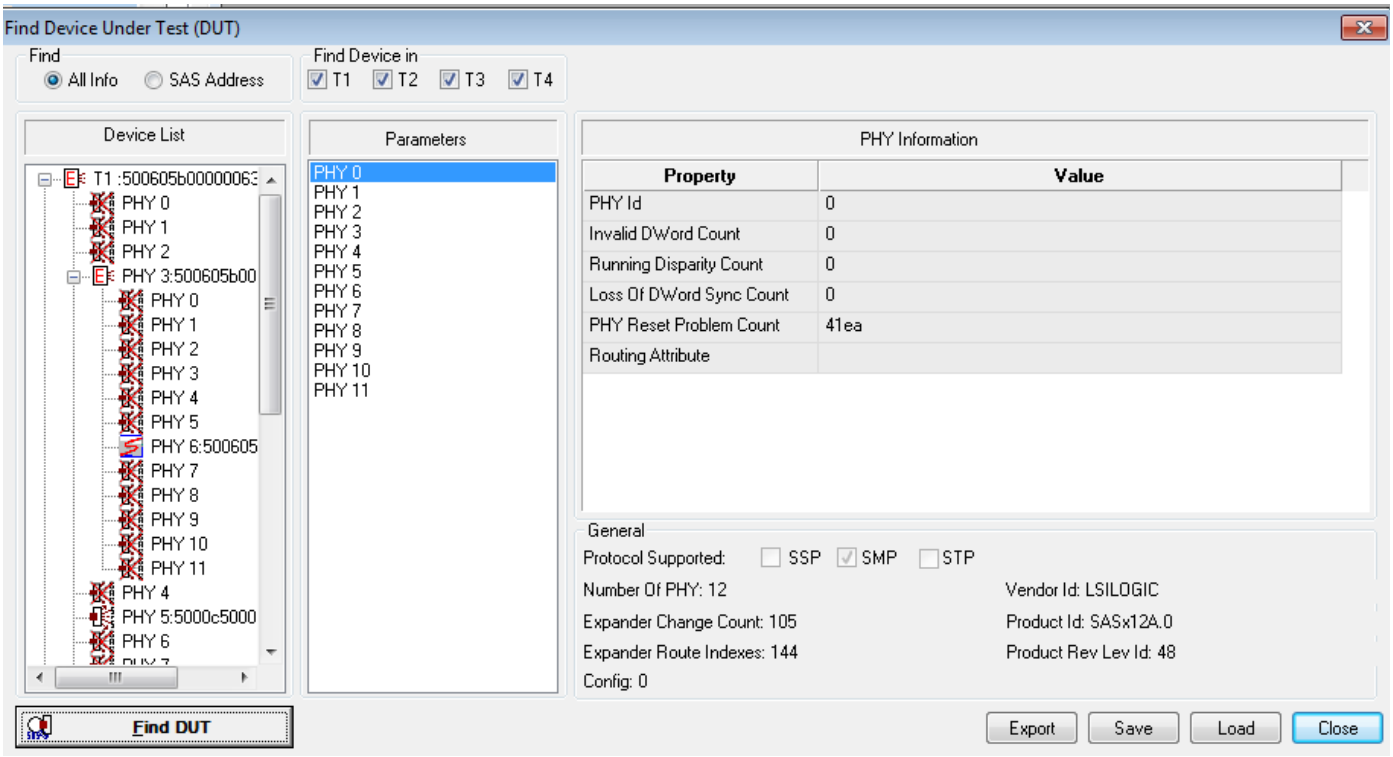


Figure 2.124: SAS: Active SAS Addresses

3. To assign commands to an active address, right-click an address and choose:
   Insert To Cursor assigns all commands up to the cursor to the chosen address.
   Insert: To All assigns all commands to the chosen address.

Note: Selecting a SAS device and clicking **Export** allows you to export in .std format. Selecting a SATA or Expander and clicking **Export** allows you to export in .txt format.

2.9.3 Record and Play

This feature allows the selection of a range of commands in a trace and exports them to a previously saved ***.sac** file for execution by the SAS Initiator Emulator or ***.stc** file for execution by the SATA Host Emulator. You can export commands from all available samples, between X and Y cursors, or between designated commands.

To perform this action:

1. Run a capture project or open a previously run and saved a captured trace file.
2. Set X and Y cursors to export between cursors (see Figure 2.125 on page 137).

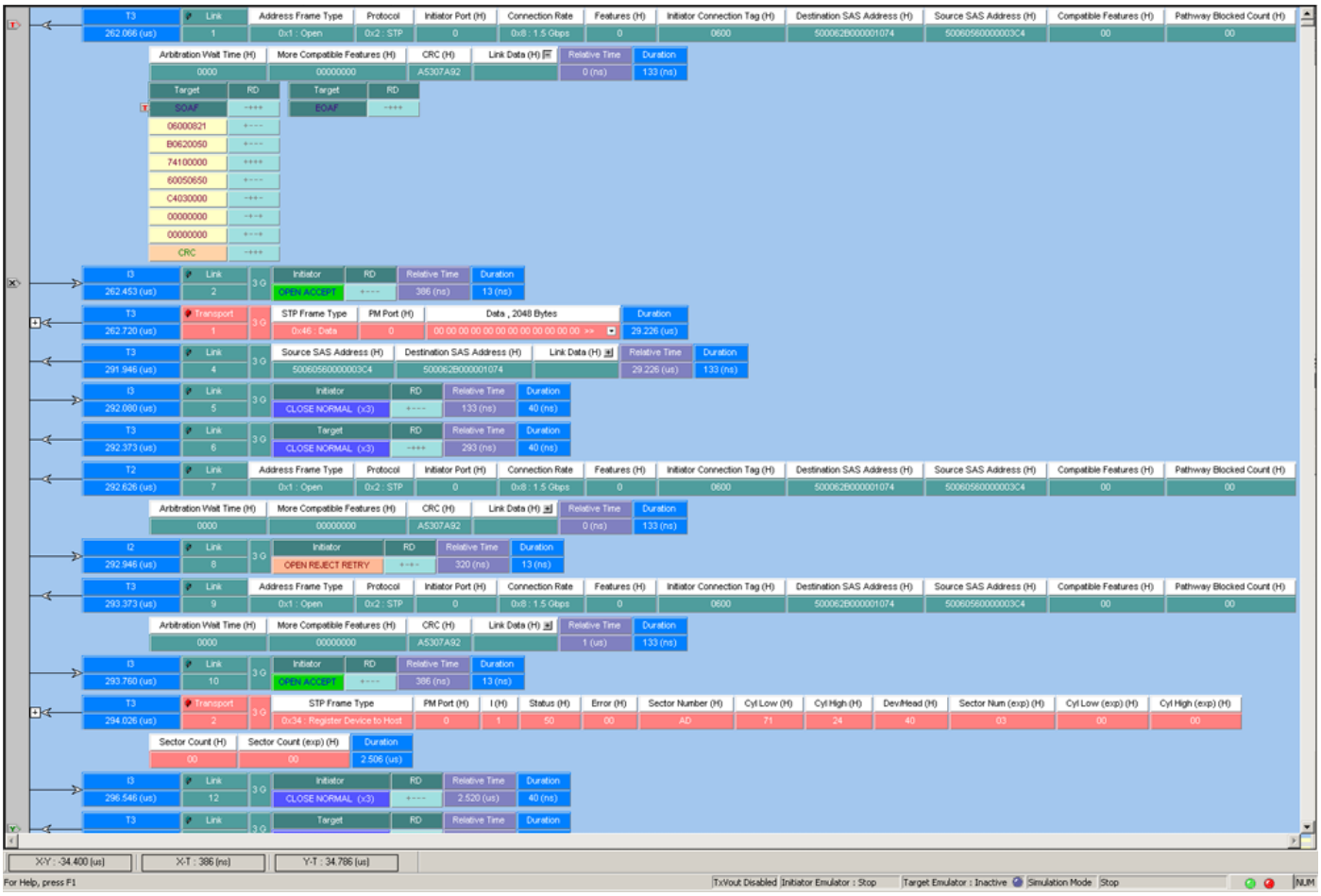


Figure 2.125: SAS: Captured Trace Display With Cursors Set

3. Click **File** and then choose **Export to Initiator Emulator** or **Export to Host Emulator.**

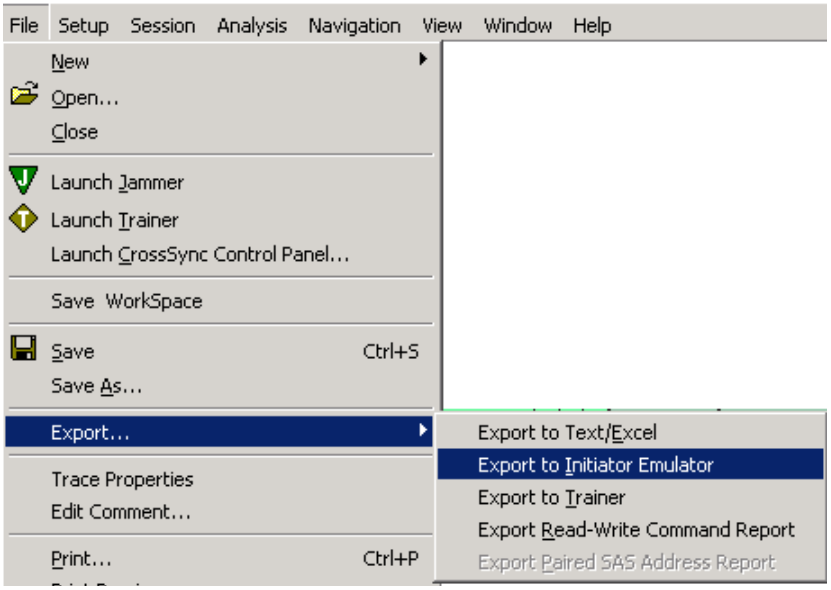


Figure 2.126: SAS: Export to Initiator Emulator

This displays the Export to Initiator Emulator dialog.

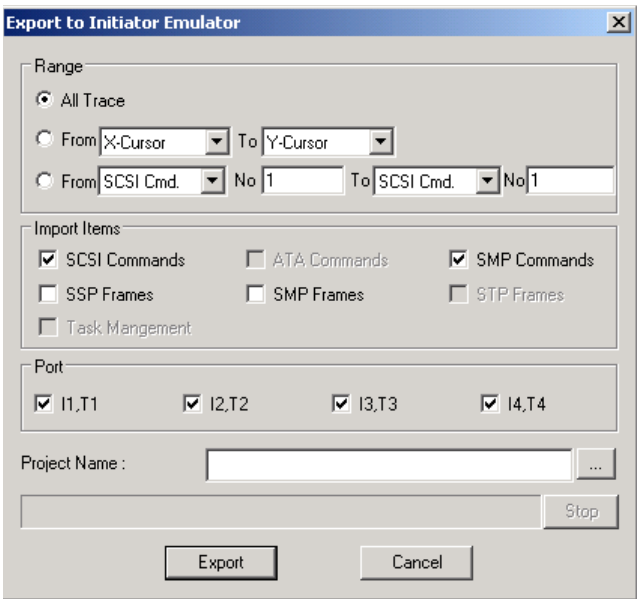


Figure 2.127: Export to Initiator Emulator Dialog

4. Click the ellipses next to the Project Name address bar and select an existing ***.sac** or ***.stc** file.
5. Choose an export range and item, Command, or FIS, then click **Export.**

6. After the export action completes, open the exported ***.sac** or ***.stc** file.

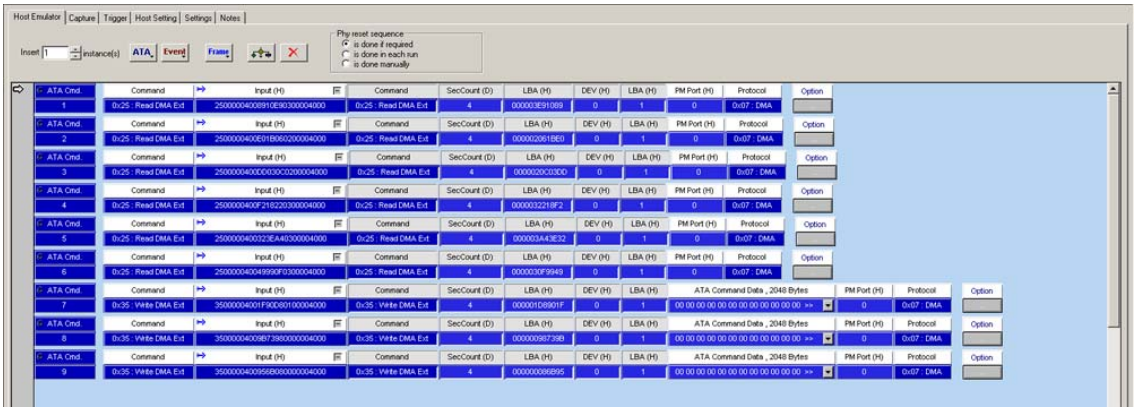


Figure 2.128: SATA: Host Emulator Program With the Exported Commands

You can run this set of commands immediately, or you can modify it by inserting instructions and/or additional commands.

2.9.4 Error and Command Settings

Each command type allows you to set a variety of command settings and to introduce errors. Click the **Option** button on a command line to display the corresponding Protocol Error and Command Settings dialog.

ATA Error and Command Settings

The Protocol Errors and Command Settings screen capture is shown below.

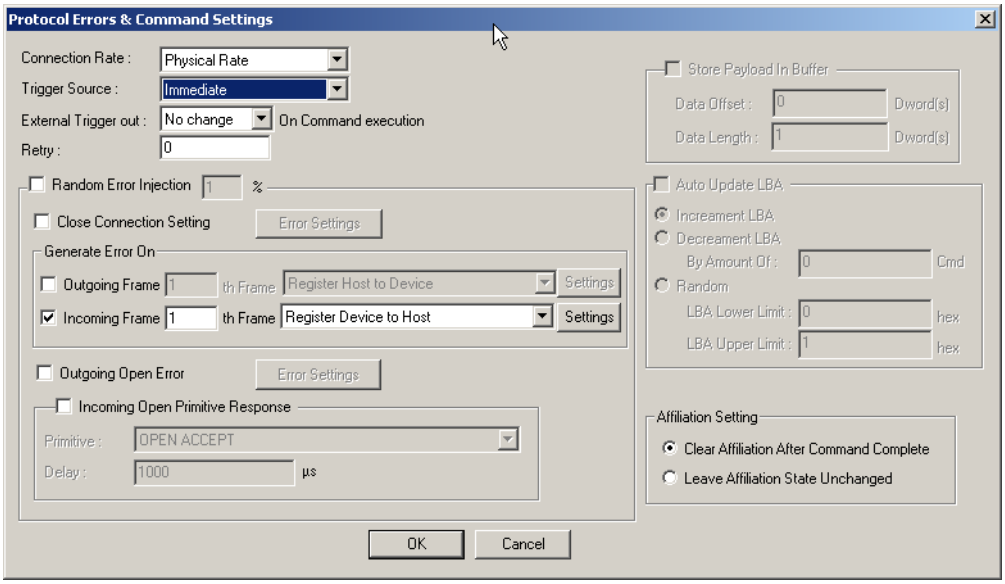


Figure 2.129: SAS: Protocol Error and Command Settings for ATA Dialog

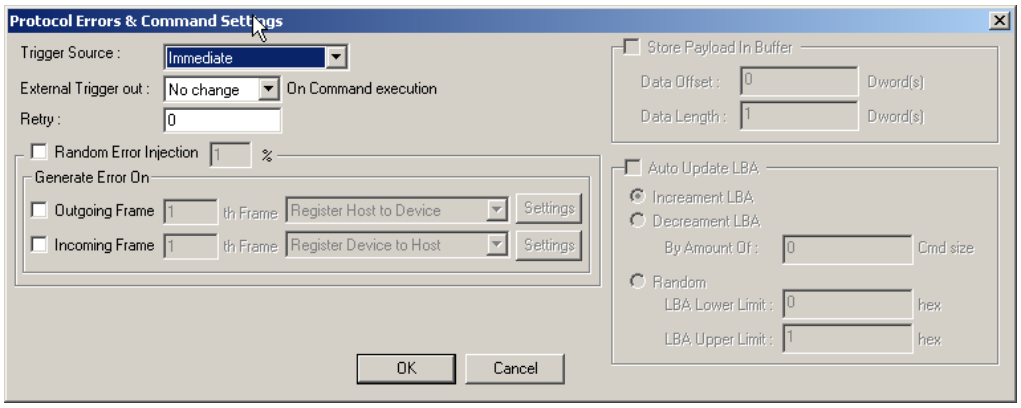


Figure 2.130: SATA: Protocol Error and Command Settings for ATA Dialog

Connection Rate

Select the Connection Rate to allow a higher speed port to communicate with a lower speed port: Physical Rate, 1.5 G, 3, or 6.

Trigger Source

Click the down arrow on the Trigger Source combo box to choose trigger type: Immediate, Wait for external trig, or Wait for Analyzer trig.

External Trigger Out

Click the down arrow on the External Trigger out combo box to choose the external trigger level: High, Low, or No change on command execution.

Retry

Enter a value for the number of command retries when a command failed in the Retry text box.

Store Payload in Buffer

Check the Store Payload in Buffer check box and enter values for Data Offset and Data Length.

Auto Update LBA

Check the Auto Update LBA check box and check an auto update option button.

Random Error Injection

Random Error Injection specifies the probability of Error Injection on the command. The probability percentage that you select applies to all Error Injection items.

Close Connection Setting

Checking Close Connection Setting enables the Error Settings button. Click this button to display the Close Connection Setting dialog.

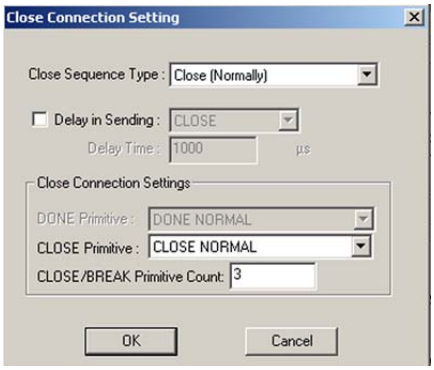


Figure 2.131: Close Connection Dialog

Select the **Close Sequence Type** from the drop-down list. Selecting **Delay in sending** allows you to specify the delay in sending Done, Close, or Break.

Select the **Close Connection Settings** from the drop-down lists.

Outgoing Open Error

Check Outgoing Open Error and then the enabled Error Settings button to display the Open Frame Setting dialog.

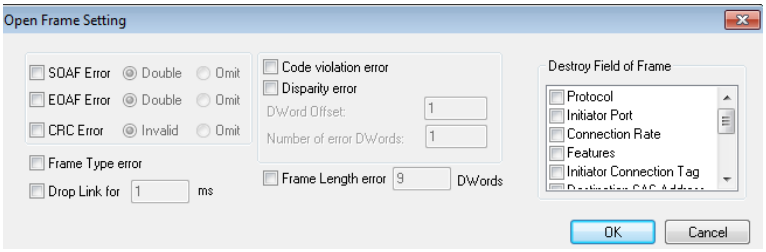


Figure 2.132: Open Frame Setting Dialog

Check errors to introduce.

Scroll through the available choices in the Destroy Field of Frame list box and check the field to destroy.

Incoming Open Primitive Response

Check this box, then click the down arrow next to the Primitive list box and choose a response type. Enter a Delay value.

Figure 2.133: Incoming Open Primitive Response Dialog

Affiliation Setting

Check Clear Affiliation After Command Complete to release device to commands from other sources, or check Leave Affiliation State Unchanged to retain control of device.

Enable First Burst

Check Enable First Burst to allow first burst.

Task Attribute

Choose Simple, Head of Queue, Ordered, or ACA.

Outgoing ATA Frame Settings

Before selecting Outgoing Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check Outgoing Frame in the Generate Error On area and then the enabled Settings button to display the Outgoing Frame Settings dialog.

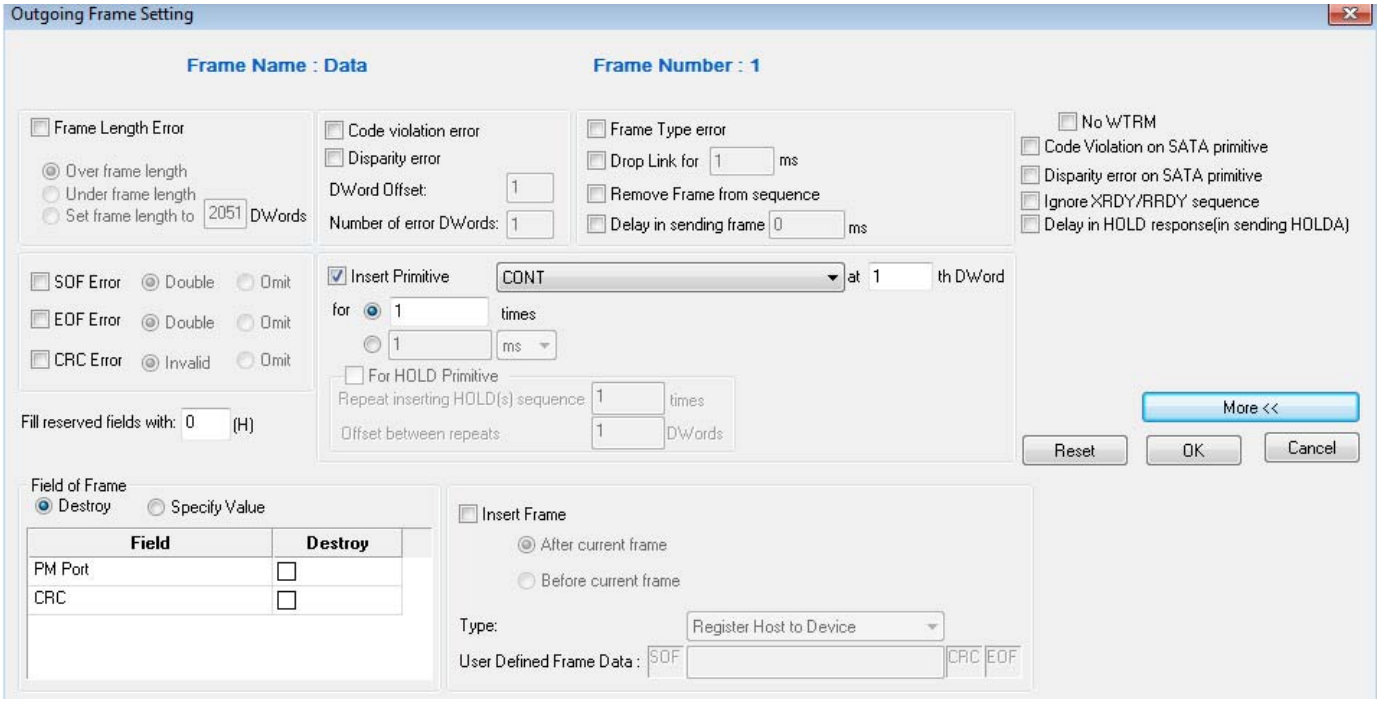


Figure 2.134: Outgoing Frame Settings

Frame Type Error

Check this to introduce a frame type error.

Remove Frame from sequence

Check this to remove frame from sequence.

Delay in sending frame

Check this to delay sending frame and enter a value for the delay.

Frame Length Error

Check Frame Length Error and choose the type of error to introduce.

Code violation and Disparity error

Check these and specify DWORD offset and number of error DWORDs.

Additionally check:

No WTRM
Code Violation on SATA primitive
Disparity error on SATA primitive
Ignore XRDY/RRDY sequence
Delay in HOLD response (in sending HOLDA)

SOF, EOF and CRC errors

Check these and specify Double or Omit by checking the corresponding option button.

Insert Primitive

Check Insert Primitive and then click the Type button to open the Primitive Type dialog and select the primitive type.

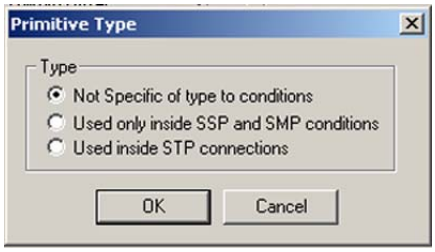


Figure 2.135: Primitive Type Dialog

Click the down arrow on the Primitive combo box, choose a primitive, then click OK.

Fill reserved fields with

Enter a value for which reserved fields to change, if other than 0.

Field of Frame

Select Destroy, scroll through the available choices in the Field of Frame list box, and choose a field to destroy. Alternatively, select Specify Value to fill the chosen field with a pre-defined value.

Insert Frame

Check Insert Frame, click the down arrow on the Type combo box, and choose the frame type.Then choose to insert it before or after an outgoing frame command. Make sure that you have clicked More.

Note: In addition to the pre-defined frame types, you can scroll down the list to **User Defined** and enter your own frame data between SOF and EOF.

Incoming ATA Frame Settings

Before selecting Incoming Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check Incoming Frame in the Generate Error On area and then the enabled Settings button to display the Incoming Frame Settings dialog.

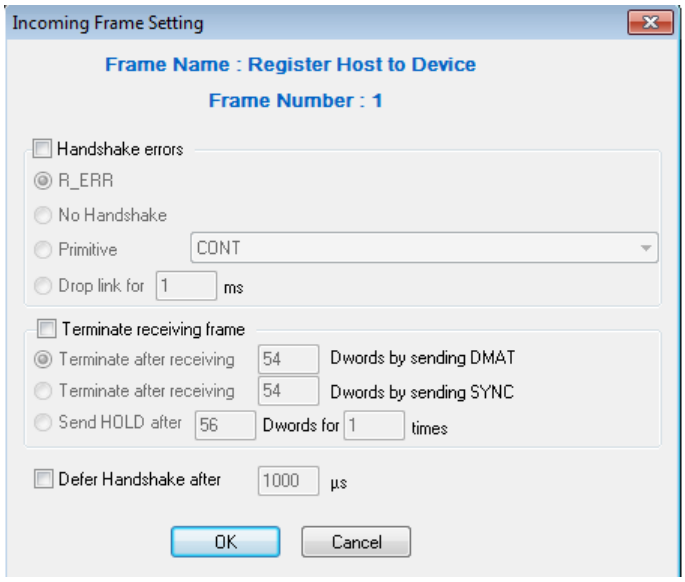


Figure 2.136: Incoming Frame Setting Dialog ATA

Handshake Error

Check Handshake Errors to enable selection of errors and primitives. Check R_ERR or select Primitive to send as an incoming frame response. Check No Handshake to send no response.

Terminate Receiving Frame

Check **Terminate Receiving Frame**, then choose the termination type.

Defer Handshake

Check the Defer Handshake after check box and enter a value for the time to defer the handshake.

SCSI Error and Command Settings (SAS only)

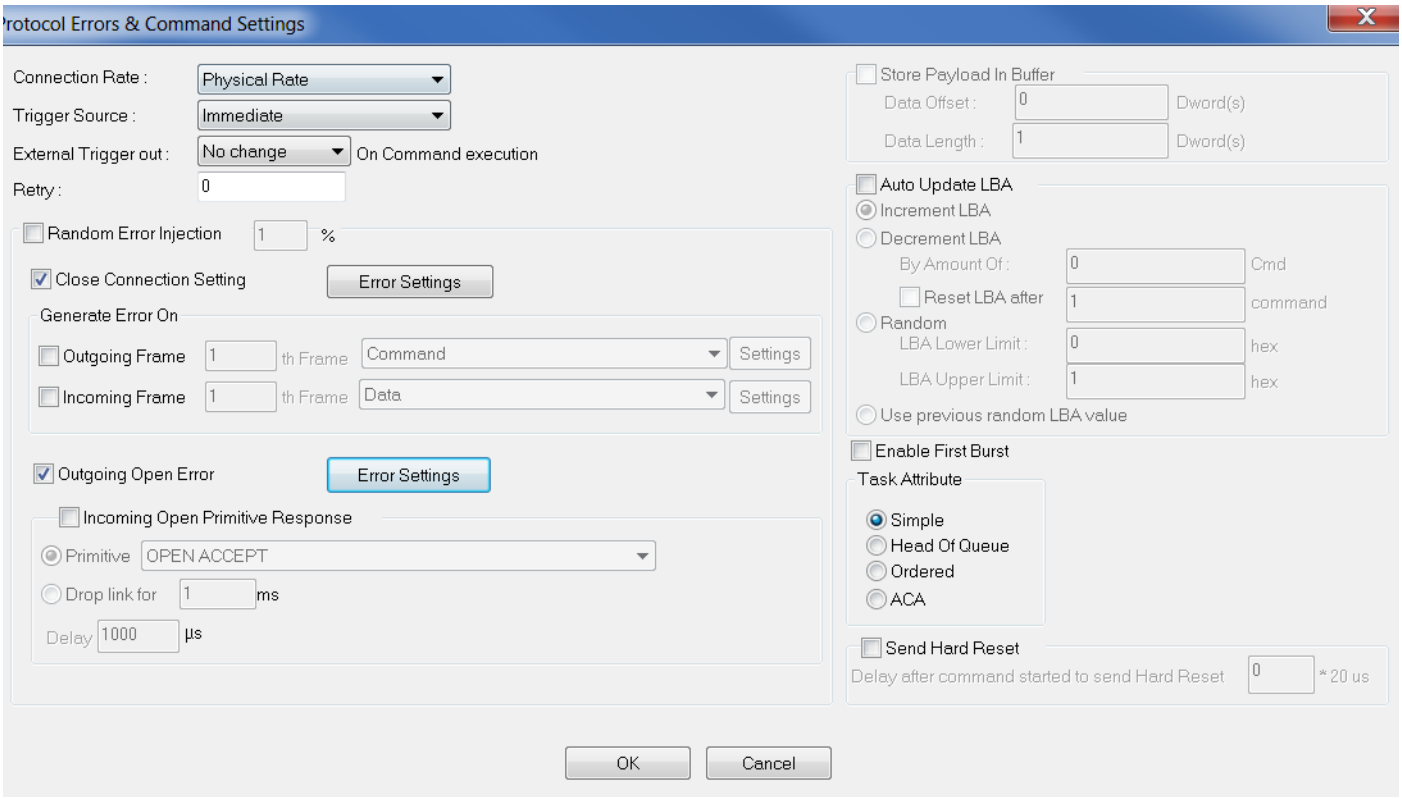


Figure 2.137: SAS: Protocol Error and Command Settings for SCSI Dialog

Connection Rate

Select the **Connection Rate** to allow a higher speed port to communicate with a lower speed port: Physical Rate, 1.5 G, 3, or 6.

Trigger Source

Click the down arrow on the Trigger Source combo box, and choose trigger type: Immediate, Wait for external trig, or Wait for Analyzer trig.

External Trigger Out

Click the down arrow on the External Trigger out combo box to choose the external trigger level: High, Low, or No change on command execution.

Retry

Enter a value for the number of command retries for failed commands in the Retry text box.

Random Error Injection

Random Error Injection specifies the probability of Error Injection on the command. The probability percentage that you select applies to all Error Injection items.

Close Connection Setting

Checking **Close Connection Settings** enables the Error Settings button. Click this button to display the Close Connection Setting dialog.

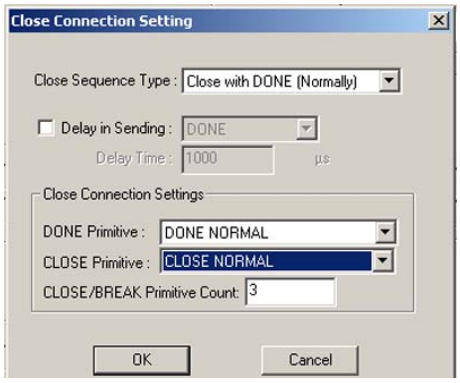


Figure 2.138: SAS: Close Connection Settings

Select a **Close Sequence Type** from the drop-down list.

Check **Delay in Sending** to specify the delay in sending Done, Close, or Break.

Select **Close Connection Settings** from the drop-down lists.

Store Payload in Buffer

This option is available for read type commands. Choose and specify **Data Offset** and **Data Length**.

Auto Update LB

Check to enable Auto Update of LBA, then specify the update by checking the option.

Outgoing Open Error

Check **Outgoing Open Error** and then the enabled Error Settings button to display the Open Frame Setting dialog.

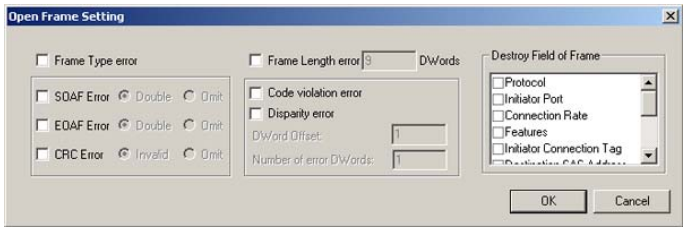


Figure 2.139: SAS: Open Frame Settings

Check the errors to introduce.

Scroll through the available choices in the **Destroy Field of Frame** list box and check the destroy field.

Incoming Open Primitive Response

To set a response to an incoming Open frame, check **Incoming Open Frame Response**, select a Primitive, and enter a value for Delay.

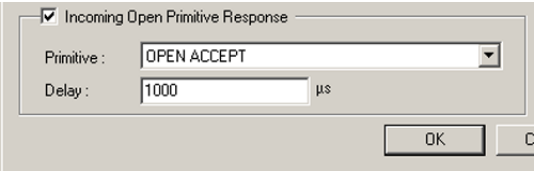


Figure 2.140: SAS: Open Primitive Response

Enable First Burst

Check the **Enable First Burst** box to specify to transfer the first burst data as defined by the First Burst Size field in the Advanced Initiator Setting dialog (see Figure 2.148 on page 154).

Task Attribute

Choose a task attribute of Simple, Head of Queue, Ordered, or ACA by checking the corresponding option button.

Outgoing SCSI Frame Settings

Before selecting Outgoing Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check **Outgoing Frame** in the Generate Error On area and then the **Settings** button to display the Outgoing Frame Setting dialog.

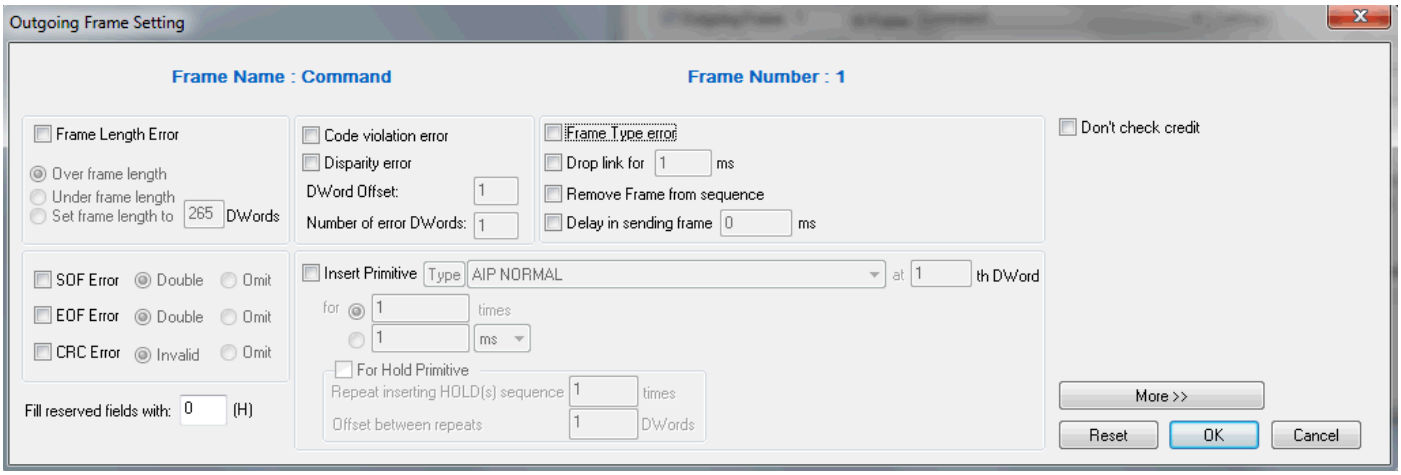


Figure 2.141: SAS: Outgoing Frame Setting Dialog SCSI

Frame Type Error

Check this to introduce a frame type error.

Drop link for

Check this to drop link for the specified milliseconds.

Remove Frame from sequence

Check this to remove frame from sequence.

Delay in sending frame

Check this to delay sending frame and enter a value for the delay.

Frame Length Error

Check **Frame Length Error,** then choose the type of error to introduce.

Code violation and Disparity error

Check these and specify DWORD offset and the number of error DWORDs.

Don’t check credit

Check this to disable credit checking.

SOF, EOF and CRC errors

Check these and specify Double or Omit by checking the corresponding option button.

Insert Primitive

Check **Insert Primitive**, click the **Type** button to open the Primitive Type dialog, then select the primitive type.

Field of Frame

Select **Destroy**, scroll through the available choices in the Field of Frame list box, and choose a field to destroy. Alternatively, you can select **Specify Value** to fill the chosen field with a pre-defined value.

Insert Frame

You can insert a frame before or after the current frame. To insert a frame, check **Insert Frame**, check the option button at which to insert the frame, and choose a Frame Type.

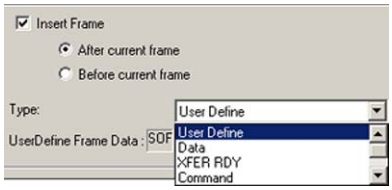


Figure 2.142: SAS: Insert Frame

Incoming SCSI Frame Settings

Before selecting Incoming Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check Incoming Frame in the Generate Error On area and then the enabled Settings button to display the Incoming Frame Setting dialog.

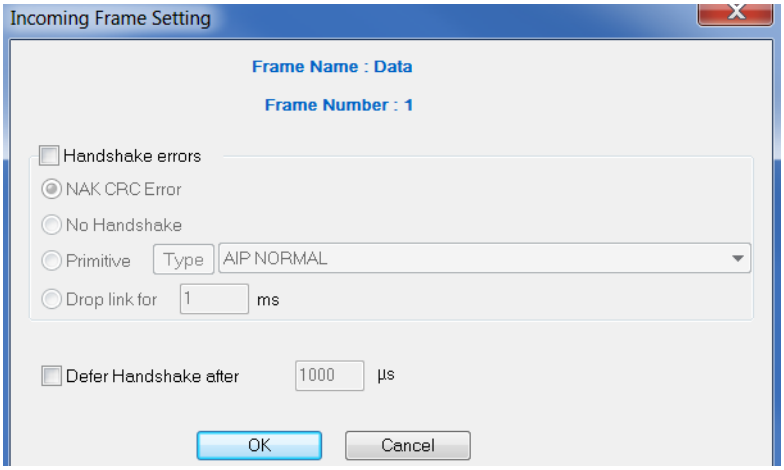


Figure 2.143: SAS: Incoming Frame Setting Dialog (SCSI)

Handshake Error

Check **Handshake Error** and select **NAK CRC Error, No Handshake**, or **Primitive** and a Primitive Type.

Defer Handshake

Check the **Defer Handshake after** check box and enter a value for the time to defer the handshake.

FIS Options (SATA only)

If you select **Frame > Host to Device**, **Frame > DMA Setup**, or **Frame > Data**, the system adds an FIS line. At the end of the line is an **Options** button that opens an Outgoing Frame Setting dialog.

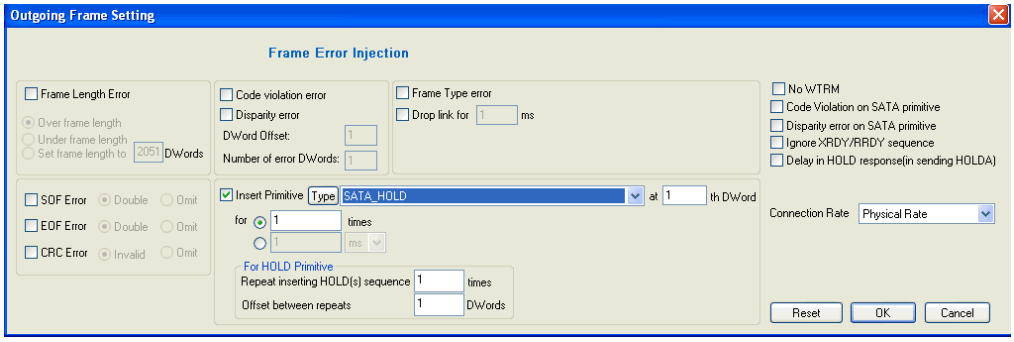


Figure 2.144: SATA: FIS Options Outgoing Frame Setting Dialog

Frame Length Error

Check **Frame Length Error,** then choose the type of error to introduce.

SOF, EOF and CRC errors

Check these and specify Double or Omit by checking the corresponding option button.

Code violation and Disparity error

Check these and specify DWORD offset and the number of error DWORDs.

Insert Primitive

Check **Insert Primitive**, click the **Type** button to open the Primitive Type dialog, then select the primitive type.

The host can send multiple bursts of HOLD primitives during a single data frame. You can repeat the HOLD sequence up to 999 times. You can enter the offset between repeats, up to 99999 DWORDs.

Frame Type Error

Check this to introduce a frame type error.

Drop Link for ... ms

Check this to drop link for the specified milliseconds.

Additionally check:

No WTRM
Code Violation on SATA primitive
Disparity error on SATA primitive
Ignore XRDY/RRDY sequence
Delay in HOLD response (in sending HOLDA)

2.9.5 Initiator Setting Tab (SAS only)

The Initiator Setting tab allows you to select the Port(s) for generating SAS traffic and to specify SAS Address, Data Frame Payload size, Frame Receive Timeout, Logical Block size, and ATA Command Execution Time out (see Figure 2.145 on page 151).

You can run a Pattern Generator. To run the Pattern generator, check the **Run Pattern Generator** option button and select a **Pattern Generator File.** You can create Pattern Generator Files (see “Creating a Pattern Generator File” on page 467).

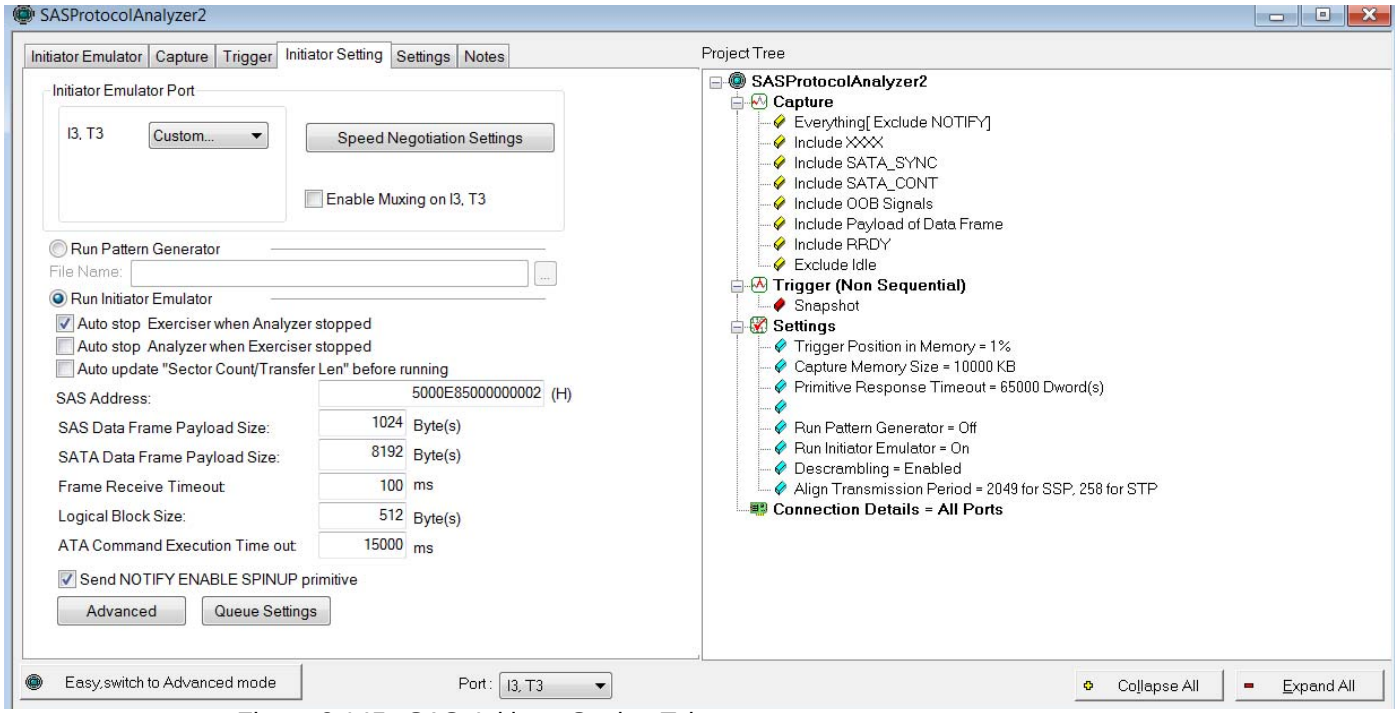


Figure 2.145: SAS: Initiator Setting Tab

Choose Initiator Emulator Port

For each port, select a speed, and then click the **Speed Negotiation Setting** button.

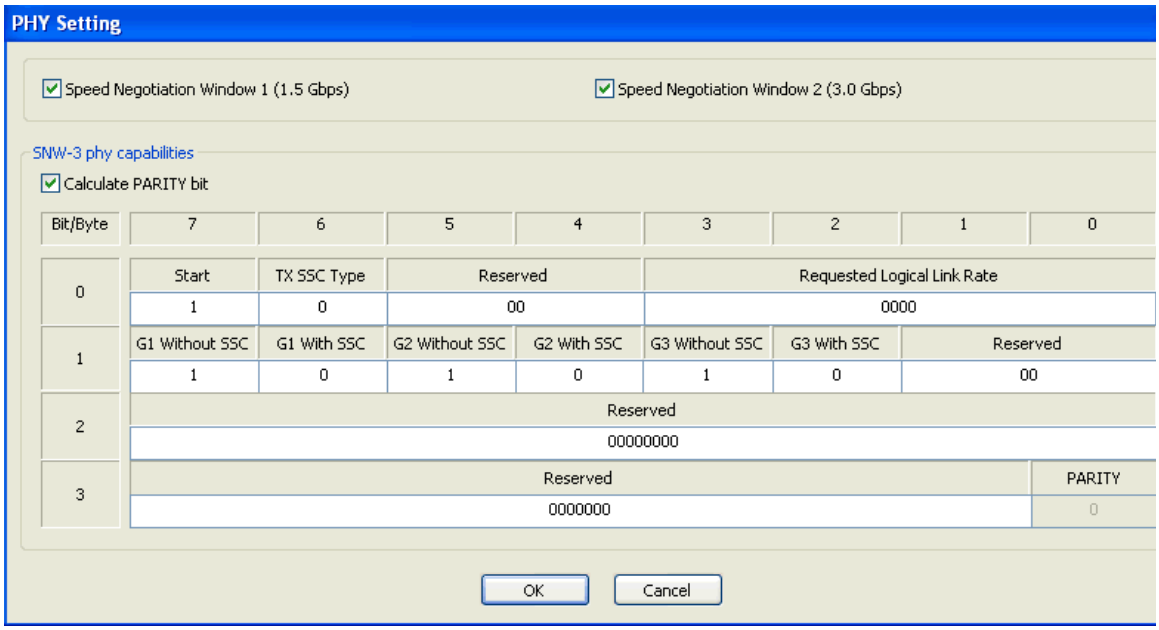


Figure 2.146: SAS: PHY Setting Dialog

Select the port speed settings (see “PHY Setting Dialog” on page 129).

After you click **OK**, you can **Enable Muxing On**.

Pattern Generator

You can select a Pattern Generation file.

Initiator Emulator

You can run an Initiator Emulator while setting:

- Auto stop Exerciser when Analyzer stopped
- Auto stop Analyzer when Exerciser stopped
- Auto update “Sector Count/Transfer Len” before running
- SAS Address
- Data Frame Payload Size
- Frame Receive Timeout
- Logical Block Size
- ATA Command Execution Timeout
- Send NOTIFY ENABLE SPINUP primitive

Check **Autostop Exerciser when Analyzer Stopped** to halt the Initiator Emulator when the Analyzer stops. If unchecked, the Exerciser continues to run even after the Analyzer stops.

Check **Autostop Analyzer when Exerciser Stopped** to halt the Initiator Emulator when the Exerciser stops. If unchecked, the Exerciser continues to run even after the Exerciser stops.

Check **Auto update “sector Count/Transfer Len” before running** - If you want to automatically calculate the sector count and transfer length per the payload data length. Keep this unchecked to use the values entered manually in the emulation script.

Note: Checking this option will manipulate the emulation script with the calculated values, but unchecking it afterwards will NOT revert to the previous values. It is recommended to save a copy of your script before checking this option. The message shown in Figure 2.153 on page 157 displays when you check this option.

Queue Settings

Click the **Queue Settings** button to display the Queue Settings dialog (see Figure 2.147 on page 153) and specify:

- Queue Depth
- NCQ Error Recovery
- Queued/Non-Queued Items Status
- NCQ/Queue Command Timeout

Specify the Queue Depth or SCSI.

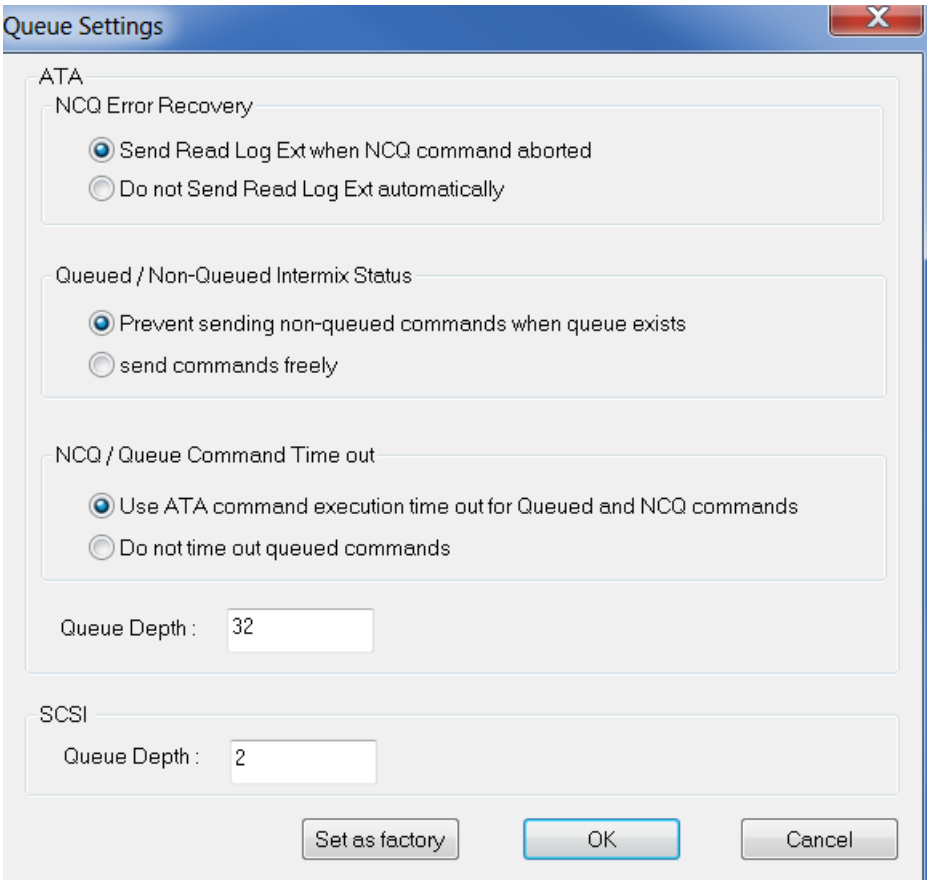

Queue Settings
ATA
NCQ Error Recovery
Send Read Log Ext when NCQ command aborted
Do not Send Read Log Ext automatically
Queued / Non-Queued Intermix Status
Prevent sending non-queued commands when queue exists
send commands freely
NCQ / Queue Command Time out
Use ATA command execution time out for Queued and NCQ commands
Do not time out queued commands
Queue Depth : 32
SCSI
Queue Depth : 2
Set as factory
OK
Cancel

Figure 2.147: Queue Setting Dialog

Advanced Initiator Settings

Click the **Advanced** button to display additional settable options (see Figure 2.148 on page 154):

- Align Transmission Period
- STP Initiator ALIGN Transmission Period
- Bus Inactivity Time Limit
- Maximum Connect Time Limit
- First Burst Size
- I_T nexus loss time
- Max Credits in each Connection
- Delay between getting HOLD and Sending HOLDA

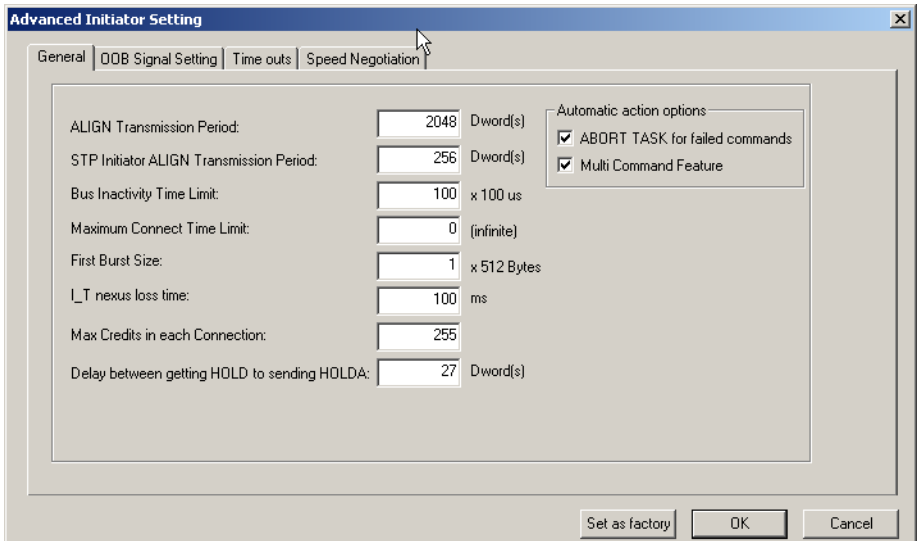


Figure 2.148: Advanced Initiator Settings Dialog General Tab

In the Advanced Initiator Setting dialog, choose **Automatic action** options from

- ABORT TASK for Failed Commands
- Multi Command feature.

OOB Signal Setting Tab

Click the **OOB Signal Setting** tab in the Advanced Host Setting dialog to specify OOB parameters in the enabled editable fields**.**

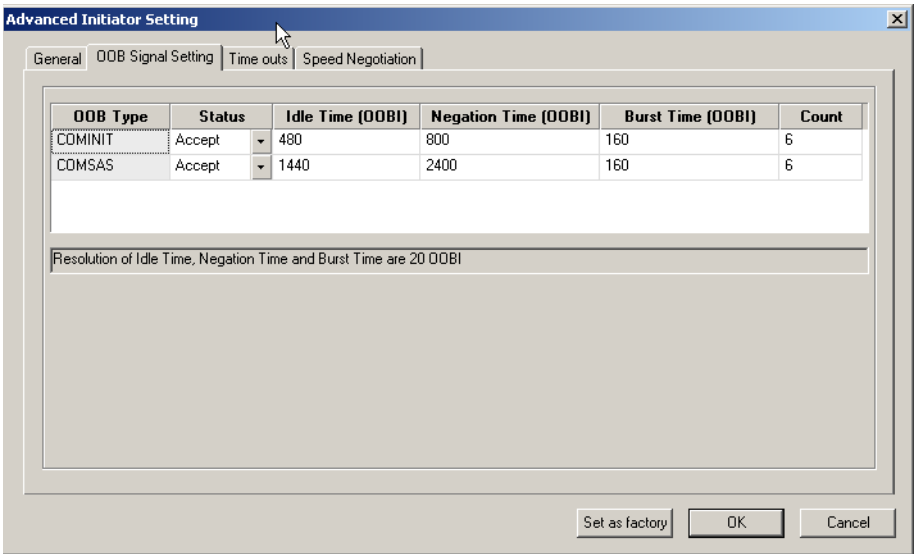


Figure 2.149: OOB Signal Setting Tab

Timeouts Tab

Click the **Timeouts** tab in the Advanced Host Setting dialog to specify timeouts for connection, CREDIT, ACK/NAK, ATA Command, OOB Signal and Identify frame.You can also edit the speed negotiation parameters.

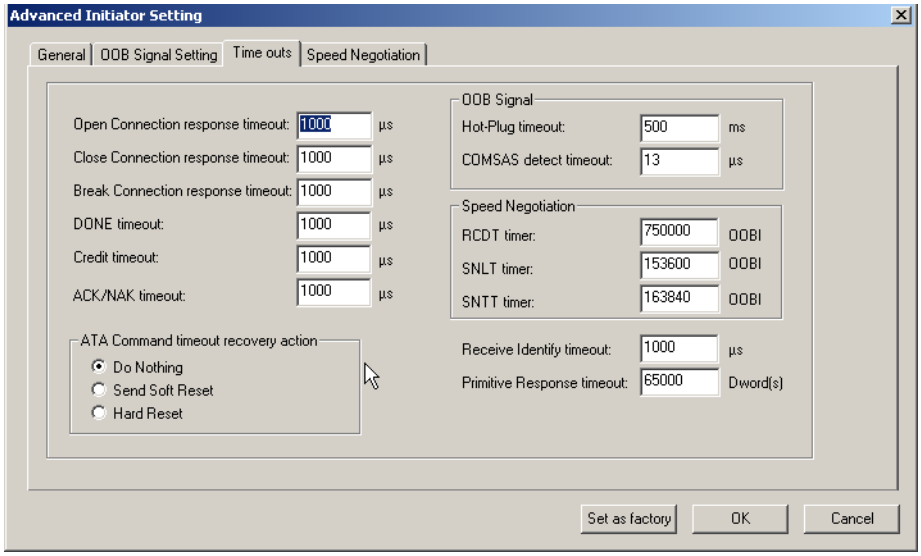


Figure 2.150: Timeouts Tab

Speed Negotiation Tab

Use the Speed Negotiation tab to inject errors during speed negotiation.

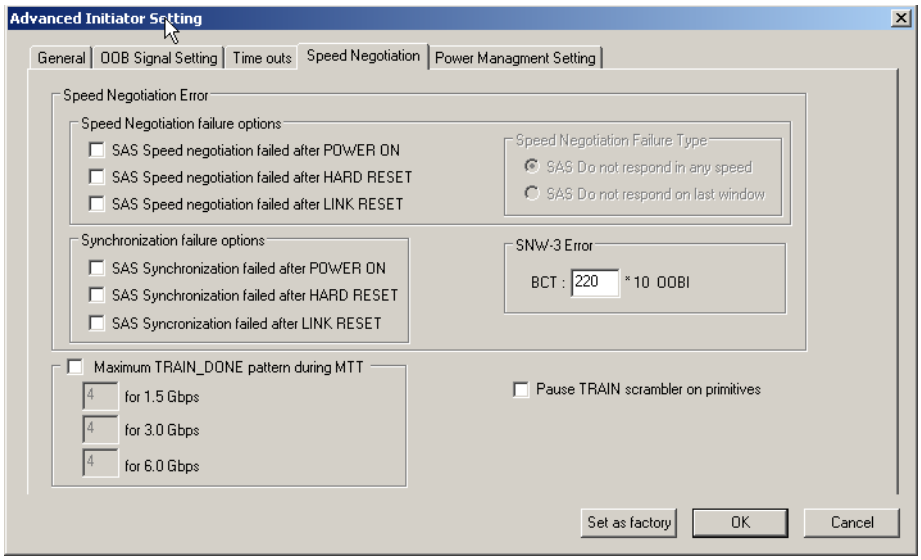

Advanced Initiator Setting
General
OOB Signal Setting
Time outs
Speed Negotiation
Power Managment Setting
Speed Negotiation Error
Speed Negotiation failure options
SAS Speed negotiation failed after POWER ON
SAS Speed negotiation failed after HARD RESET
SAS Speed negotiation failed after LINK RESET
Speed Negotiation Failure Type
SAS Do not respond in any speed
SAS Do not respond on last window
Synchronization failure options
SAS Synchronization failed after POWER ON
SAS Synchronization failed after HARD RESET
SAS Syncronization failed after LINK RESET
SNW-3 Error
BCT : 220 * 10 OOBI
Maximum TRAIN_DONE pattern during MTT
4 for 1.5 Gbps
4 for 3.0 Gbps
4 for 6.0 Gbps
Pause TRAIN scrambler on primitives
Set as factory
OK
Cancel

Figure 2.151: Speed Negotiation Tab

2.9.6 Host Setting Tab (SATA)

The Host Emulator Setting dialog allows you to select the Port(s) for exercising, choose to use the Host Emulator or Pattern generator and specify Host Emulator characteristics. Click the **Host Setting** tab.

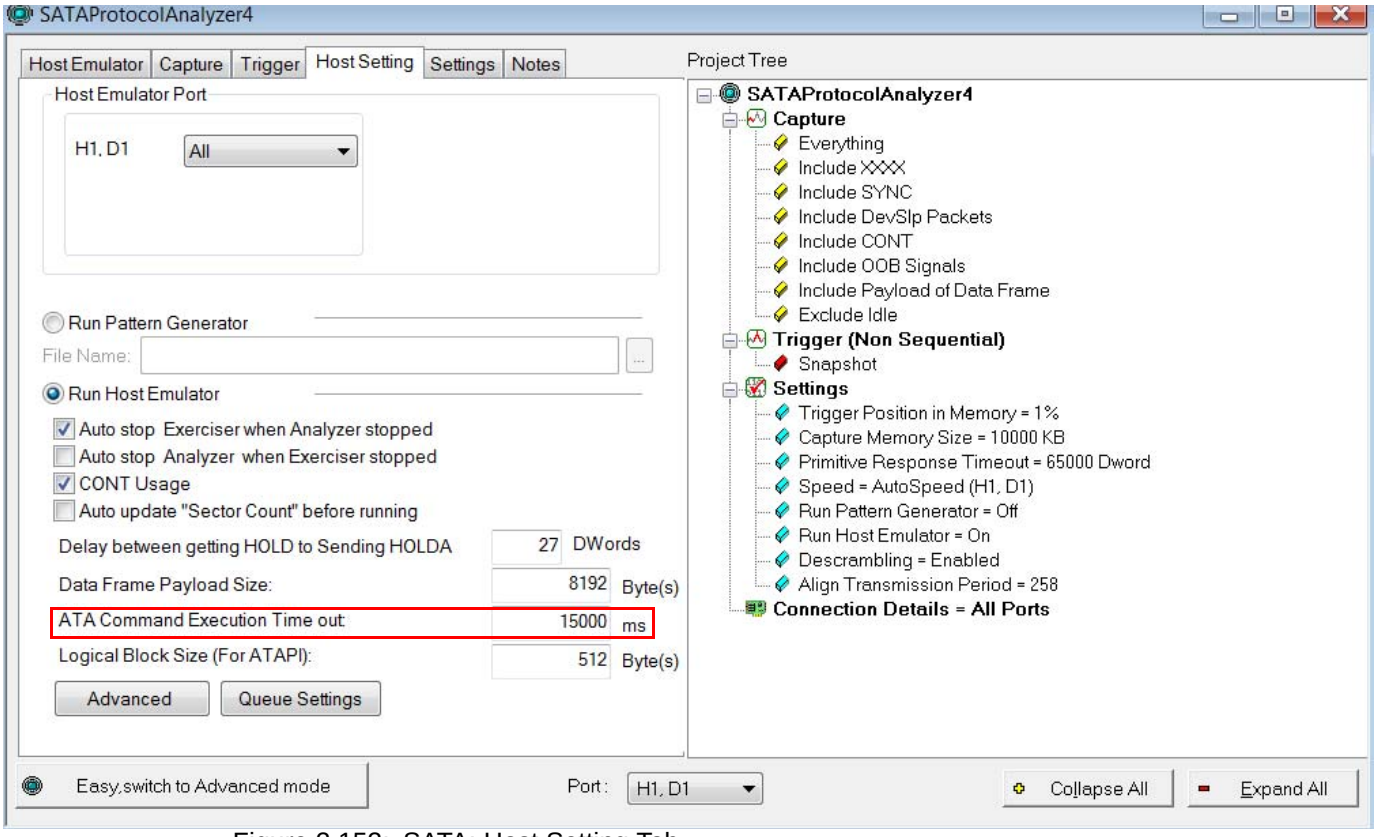


Figure 2.152: SATA: Host Setting Tab

Choose Host Emulator Port

For each port, select a speed.

Pattern Generator

You can select a Pattern Generation file. To perform a capture with a Pattern Generator, enter a path to a pattern generator ***.spg** file in the File Name dialog. See “Creating a Pattern Generator File” on page 473 for instructions how to create a Pattern Generator file.

Host Emulator

You can run an Host Emulator while setting:

- Auto stop Exerciser when Analyzer stops
- Auto stop Analyzer when Exerciser stopped
- CONT usage
- Auto update “Sector Count” before running
- Delay between getting HOLD to Sending HOLDA

- ❑ Data Frame Payload Size
- ❑ ATA Command Execution Timeout
- ❑ Logical Block Size (for ATAPI)

Check **Autostop exerciser when Analyzer Stopped** to halt the Host Emulator when the Analyzer stops.

Check **Autostop Analyzer when Exerciser Stopped** to halt the Initiator Emulator when the Exerciser stops. If unchecked, the Exerciser continues to run even after the Exerciser stops.

Check **CONT Usage** to enable the specification of **Delay between getting HOLD to sending HOLDA**, **Data Frame Payload Size,** and **ATA Command Execution Timeout**.

Check **Auto update "Sector Count" before running** - If you want to automatically calculate the sector count and transfer length per the payload data length. Keep this unchecked to use the values entered manually in the emulation script.

Note: Checking this option will manipulate the emulation script with the calculated values, but unchecking it afterwards will NOT revert to the previous values. It is recommended to save a copy of your script before checking this option. The message shown in Figure 2.153 on page 157 displays when you check this option.

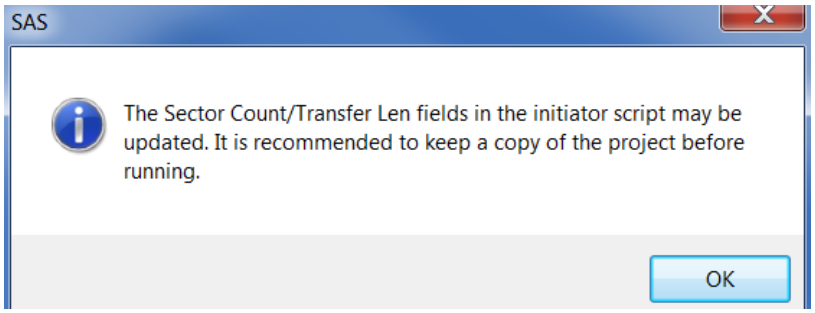

SAS
The Sector Count/Transfer Len fields in the initiator script may be updated. It is recommended to keep a copy of the project before running.
OK

Figure 2.153: Auto Update Message

ATA Command Execution Timeout

The ATA Command Execution Timeout is a timeout for ATA commands. When the host sends an H2D frame (i.e., it issues a command) and receives an R_OK from the device, it starts this timer. If the execution of the command takes more than the timeout specified (15 seconds is the default), the host emulator performs the action specified in the Advanced/General/ ATA command timeout recovery action settings. The options are Nothing, Send Soft Reset and Hard Reset.

Queue Settings

Click the **Queue Settings** button to display the Queue Settings dialog (see Figure 2.154 on page 158)and specify:

- ❑ Queue Depth
- ❑ NCQ Error Recovery
- ❑ Queued/Non-Queued Items Status

- NCQ/Queue Command Timeout

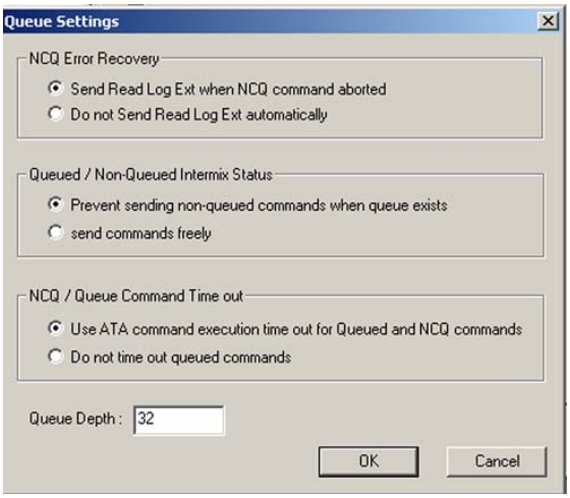

Queue Settings
NCQ Error Recovery
Send Read Log Ext when NCQ command aborted
Do not Send Read Log Ext automatically
Queued / Non-Queued Intermix Status
Prevent sending non-queued commands when queue exists
send commands freely
NCQ / Queue Command Time out
Use ATA command execution time out for Queued and NCQ commands
Do not time out queued commands
Queue Depth :
32
OK
Cancel

Figure 2.154: SATA: Queue Settings Dialog

Advanced Host Setting Dialog

Click the **Advanced** button to display all settable options.

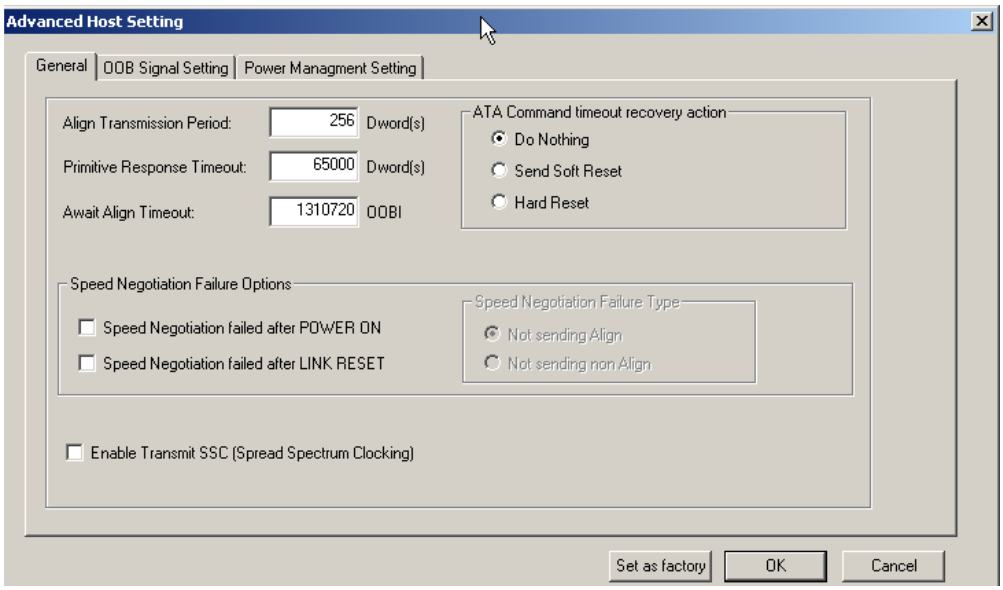


Figure 2.155: SATA: Advanced Host Setting Dialog General Tab

Settable options are:

- Set **Align Transmission Period**, **Primitive Response Timeout** and **Await Align Timeout**.
- Choose **ATA Command timeout recovery action** by checking the corresponding option button.
- Specify **Speed Negotiating Failure Option(s)** and a **Speed Negotiation Failure Type**.

OOB Signal Setting Tab

Click the **OOB Signal Setting** tab in the Advanced Host Setting dialog to specify OOB parameters in the enabled editable fields.

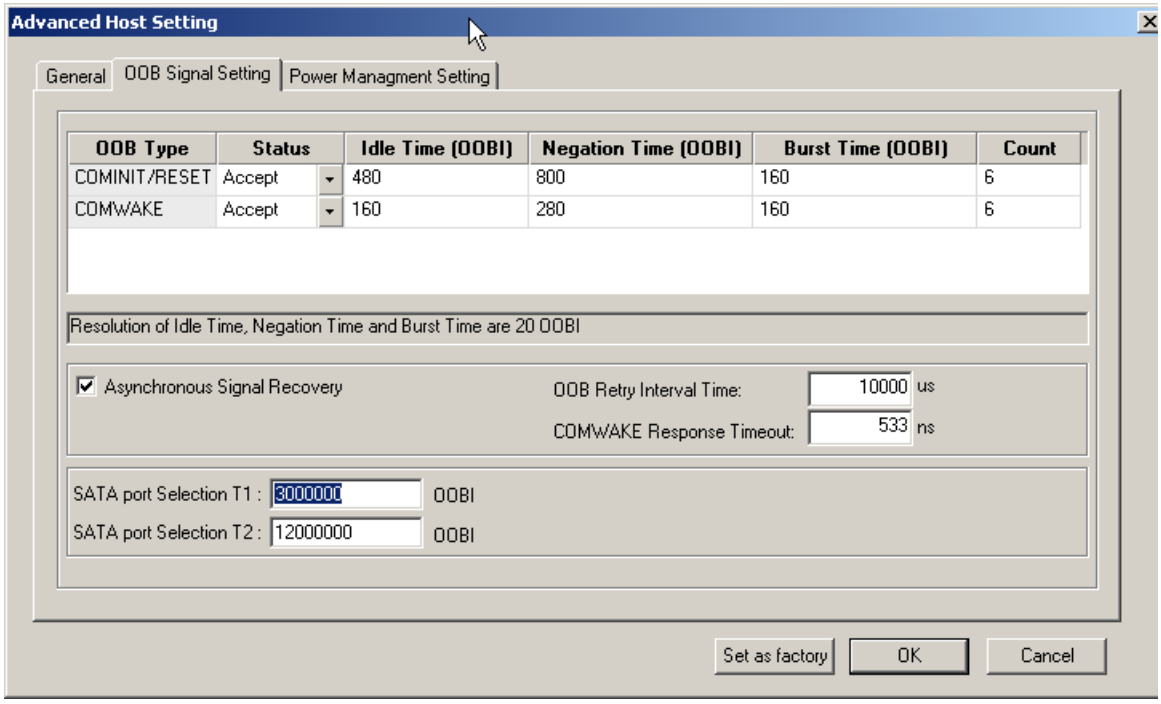


Figure 2.156: SATA: OOB Signal Setting Tab

The Device Sleep function in the Host Emulator script has an option to select **COMRESET** or **COMWAKE** commands (see Figure 2.157 on page 160).

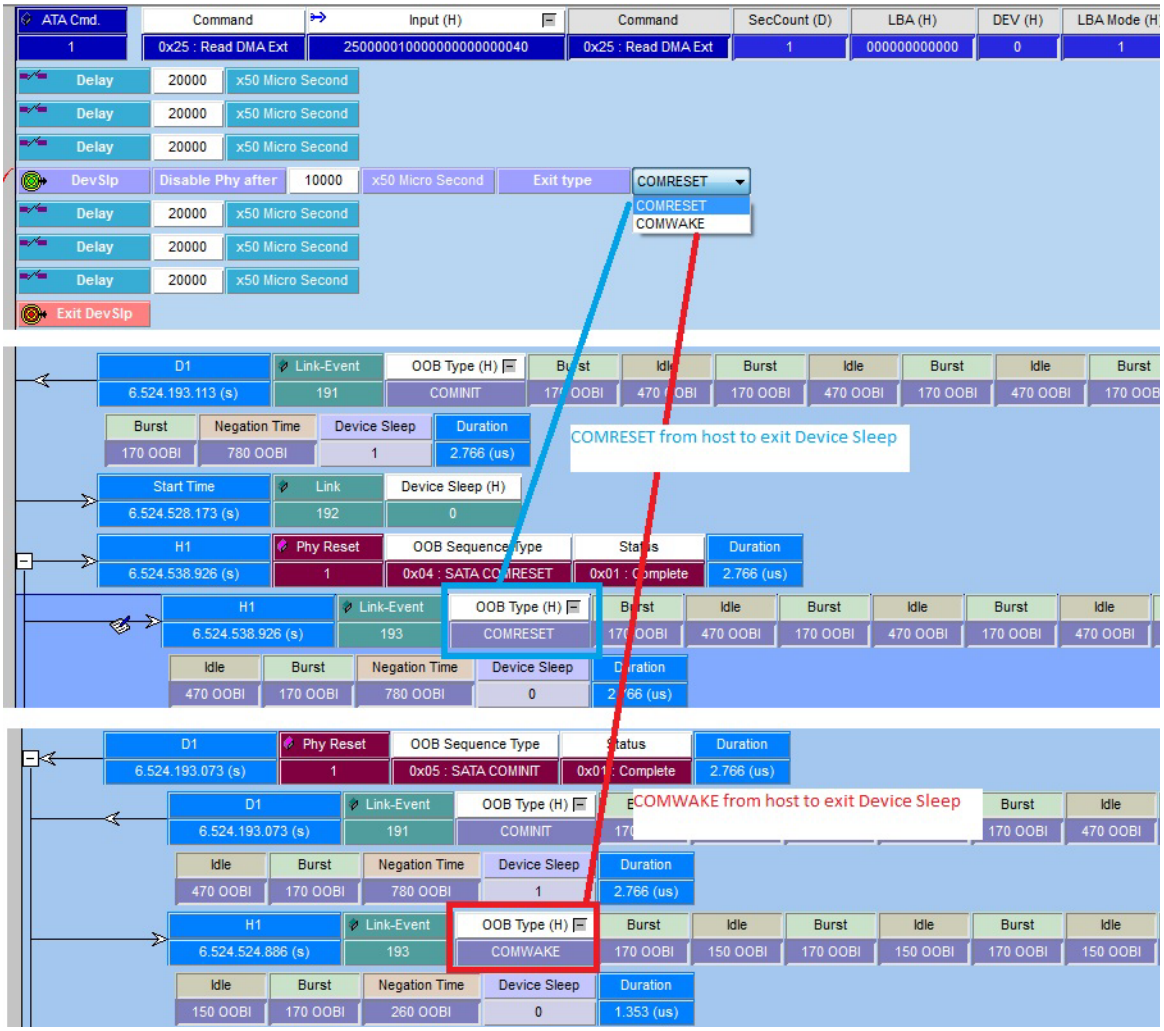


Figure 2.157: SATA: Selecting COMRESET or COMWAKE Command

Asynchronous signal recovery

Set the OOB Retry Interval Time, check the Asynchronous signal recovery option check box and enter a value for the time.

Inter-reset Delay Settings

Enter a value for **SATA port Selection T1** to specify the inter-reset- assertion delay for the first event of the selection sequence and **SATA port Selection T2** to specify the inter-reset- assertion delay for the second event of the selection sequence.

Power Management Settings

Click the **Power Management Setting** tab in the Advanced Host Setting dialog to specify the settings in the editable fields.

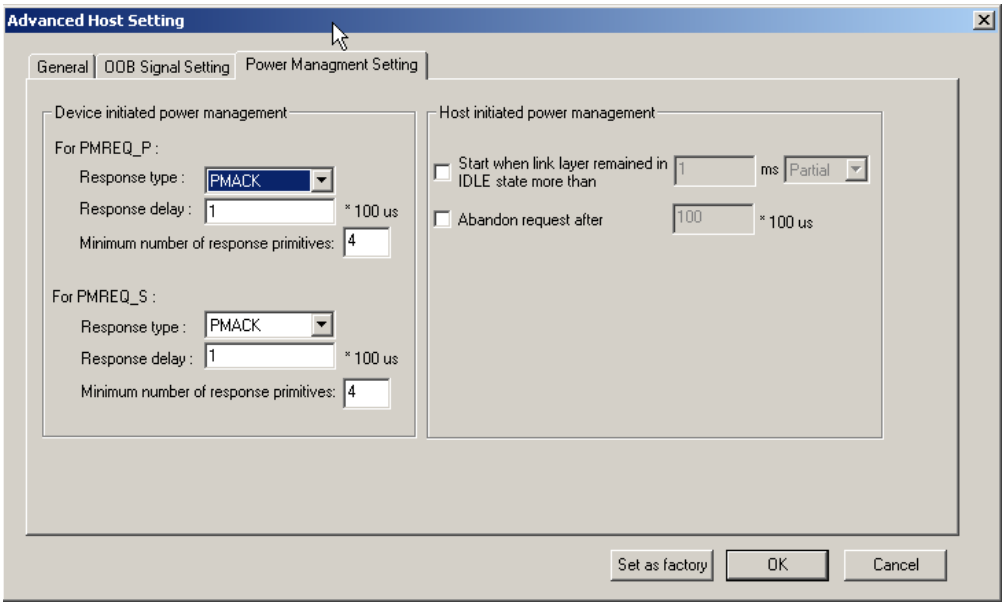


Figure 2.158: SATA: Power Management Settings

Set parameters for Host and/or Device initiated power management.

2.9.7 Project Settings

Set project settings in the Project Settings tab (see “Project Settings” on page 101).

Note: When using the Exerciser, channel 2 is not available and is grey.

2.9.8 Creating a Data Block

You can create the following types of data blocks, for use with data fields:

- Random data pattern
- Custom data pattern specifically for your application
- Counter data pattern
- Walking bit pattern

To create a data block, click the **Default Data Block** button on the Main toolbar, or select **Setup > Data Block** to open the Data Block dialog box (see Figure 2.159).

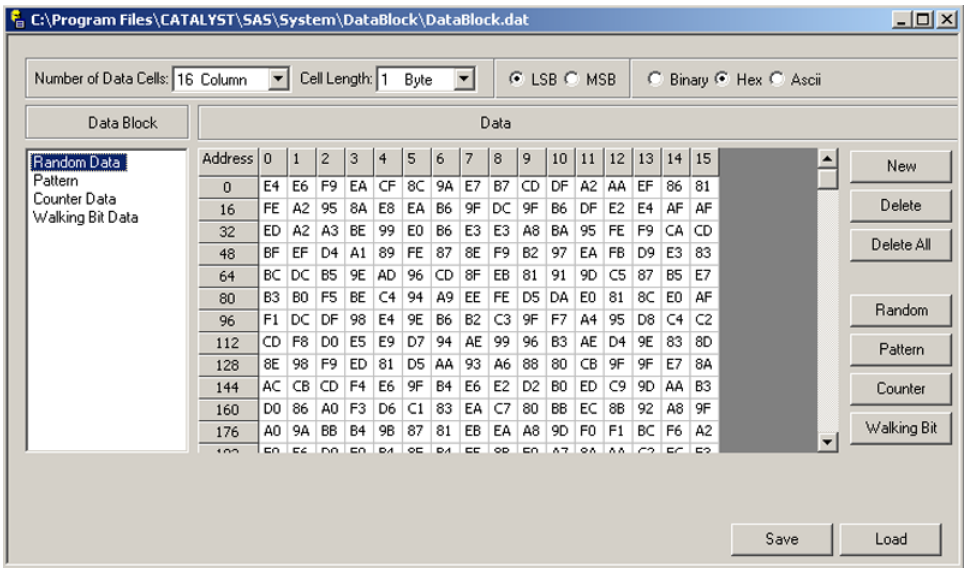

C:\Program Files\CATALYST\SAS\System\DataBlock\DataBlock.dat
Number of Data Cells: 16 Column
Cell Length: 1 Byte
LSB MSB
Binary Hex Ascii
Data Block
Data
Random Data
Pattern
Counter Data
Walking Bit Data
Address 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 E4 E6 F9 EA CF 8C 9A E7 B7 CD DF A2 AA EF 86 81
16 FE A2 95 8A E8 EA B6 9F DC 9F B6 DF E2 E4 AF AF
32 ED A2 A3 BE 99 E0 B6 E3 E3 A8 BA 95 FE F9 CA CD
48 BF EF D4 A1 89 FE 87 8E F9 B2 97 EA FB D9 E3 83
64 BC DC B5 9E AD 96 CD 8F EB 81 91 9D C5 87 B5 E7
80 B3 B0 F5 BE C4 94 A9 EE FE D5 DA E0 81 8C E0 AF
96 F1 DC DF 98 E4 9E B6 B2 C3 9F F7 A4 95 D8 C4 C2
112 CD F8 D0 E5 E9 D7 94 AE 99 96 B3 AE D4 9E 83 8D
128 8E 98 F9 ED 81 D5 AA 93 A6 88 80 CB 9F 9F E7 8A
144 AC CB CD F4 E6 9F B4 E6 E2 D2 B0 ED C9 9D AA B3
160 D0 86 A0 F3 D6 C1 83 EA C7 80 BB EC 8B 92 A8 9F
176 A0 9A BB B4 9B 87 81 EB EA A8 9D F0 F1 BC F6 A2
New
Delete
Delete All
Random
Pattern
Counter
Walking Bit
Save
Load

Figure 2.159: Default Data Block Dialog Box

To add another data block:

1. Click the **New** button in the Data Block dialog box.

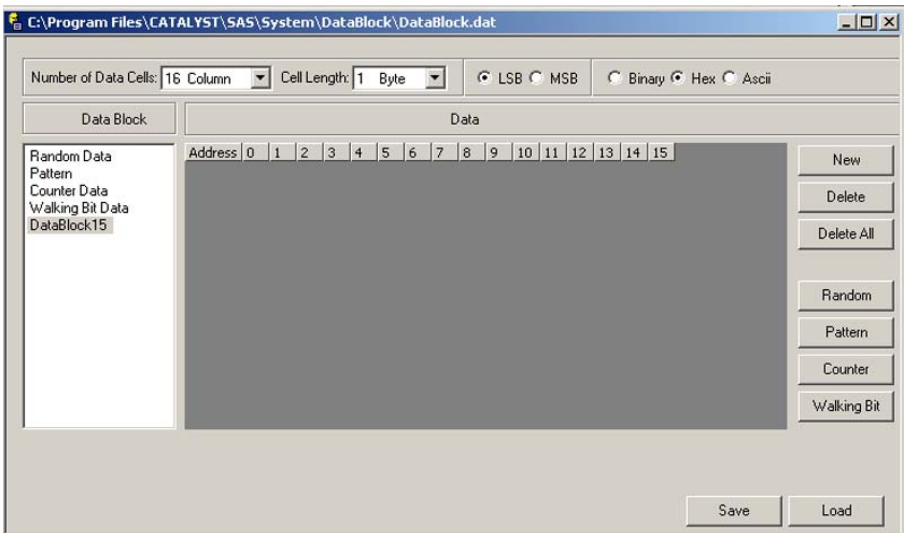


Figure 2.160: New Data Block Dialog Box

2. Choose the number of data columns (up to 16 data cells/row) and the cell length (up to 16 bytes/cell). This is a display function only.
3. Click either the **Bin, Hex**, or **Ascii** option button to choose a number format.
4. Click either the **LSB** or **MSB** option button to choose a bit order.

Naming a Data Block

Each new data block automatically receives a sequential data block number. To assign a unique descriptive name to a data block, right-click the data block name to open the Data Block Edit menu.

Figure 2.161: Data Block Edit

Choose **Rename.**

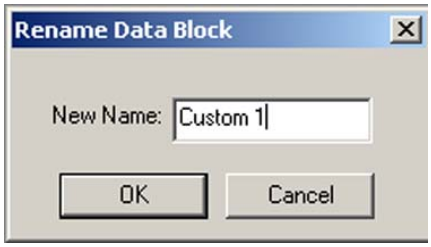


Figure 2.162: Rename Data Block

Enter a descriptive name in the New Name edit box and click **OK.**

Editing a Data Block

You can enter data in the defined cell structure by these methods:

- Define your own pattern
- Set a counter
- Choose a Random Pattern
- Choose a Walking Bit Pattern

Define Your Own Pattern

To define a pattern:

1. Click **Pattern** to open the Define Pattern dialog box (see Figure 2.163 on page 164).
2. Enter a data pattern in the Data Pattern edit box.
3. Choose the number of times to repeat that pattern, and click **OK.**

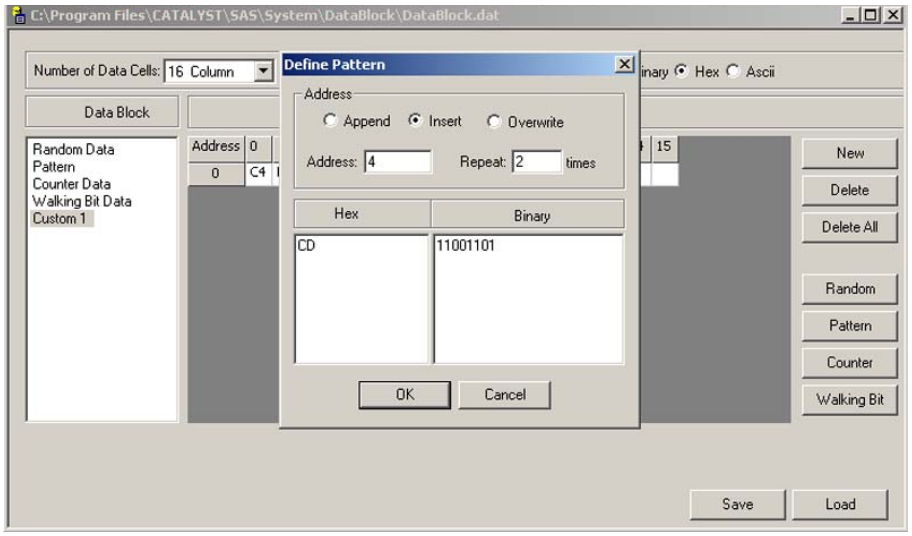


Figure 2.163: Define Your Own Data Pattern

Address

The cell address starts at 0 for the first data entry and automatically increments to the next available address. You can set it to a previously defined address to modify its content or insert additional data.

Insert/Overwrite Data

To define whether to overwrite data in a previously defined cell or insert new data after that cell, toggle the Insert/Overwrite button.

Save

When you have completed a data block definition, click the Save button to save the newly created data block.

Counter

To use a counter as data, click the **Counter** button, enter a Starting Number for the counter and the data address to count to, and click **OK** (see Figure 2.164 on page 165).

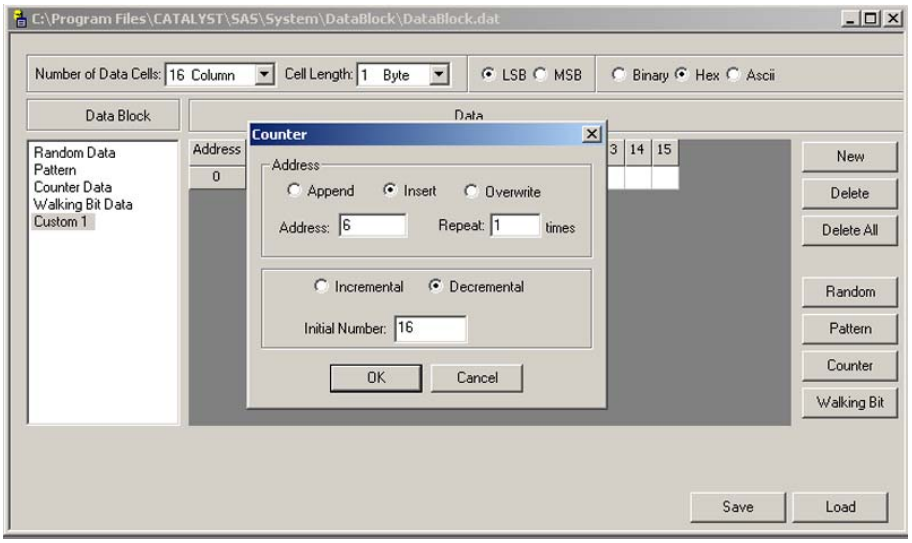


Figure 2.164: Set Counter as Data

Random Data Pattern

To use a random data pattern, click the **Random** button, enter the number of times to repeat the pattern, and click **OK**.

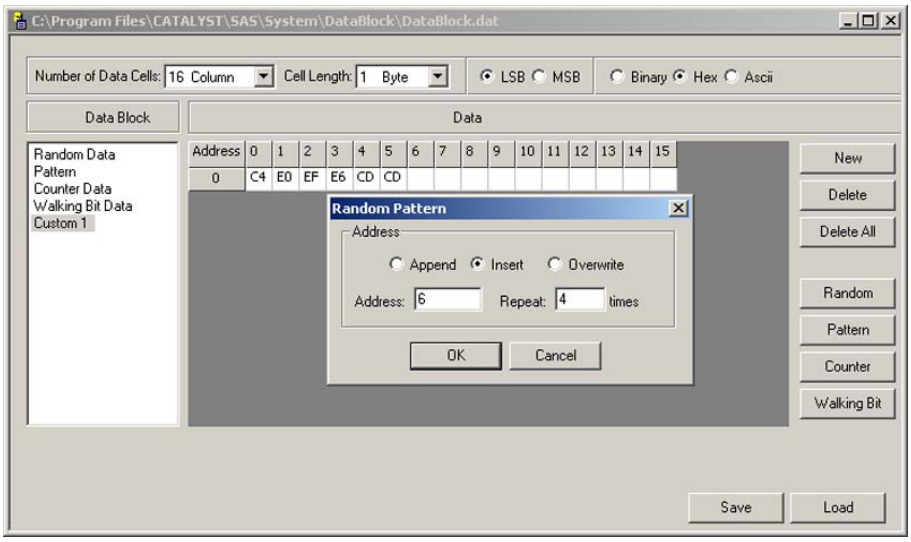


Figure 2.165: Choose a Random Pattern

Walking Bit Pattern

To use a walking bit pattern, click the **Walking Bit** button, then choose either a walking bit of “0” or “1”, the walk direction, the start position, and the number of times to repeat the pattern (see Figure 2.166 on page 166).

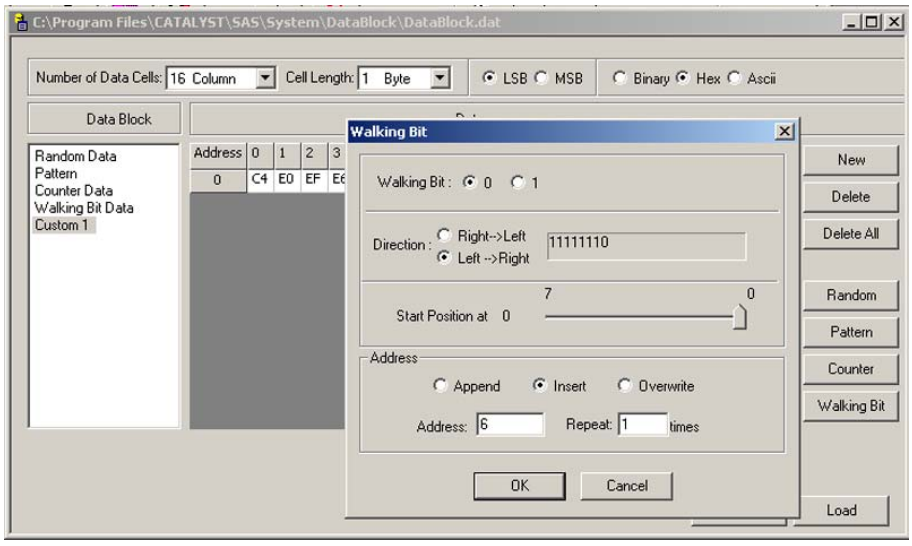


Figure 2.166: Define a Walking Bit Pattern

Creating and Editing Data Blocks as Text

You can create and edit data blocks using a text editor such as Windows® Notepad. To create a data block in Notepad, launch Notepad. Enter a header consisting of [Item1, Item2, Item3, Item4, Item5] where:

Item1 is the name of the Data Block.

Item2 is the size of the Data Block or the number of bytes in the format.

Item3 is the format of the data (HEX, BIN, ASCII).

Item4 is the group of bytes defined (1, 2, 4, 8 or 16).

Item5 is the direction (LSB or MSB).

Then enter the data in space delimited Hex format and save as a *.txt text file.

Load Data

To import Text Editor created data, click the **Load** button in the data block definition dialog to open the Load dialog. Choose a file and click **Load.** Modify existing data.

Save As

To create a new data block from an existing data block using a text editor, select the data block to edit from the **Data Block Name** list, then click **Save As** to open the Save As dialog.

Assign a name to the new data block text file and click **Save**.

You can now edit the newly created text file using Notepad or any other text editor, then import it into the data block definition, as described above.

2.10 Performance Analysis

An Analyzer incorporates a real-time Performance Analysis capability, to allow you to quickly measure performance parameters. You can select the format for the results display. You can set the Area and Column. You can use Bar, Line, or Pie charts with 3D and Grid enhancement options.

2.10.1 Performance Analysis with Analyzer Only

Note: Only Performance Analysis with Analyzer is supported. Performance Analysis with Emulation, Trainer, or InFusion is not supported.

New Performance Analysis Project

To perform a Performance Analysis on bus traffic and start a **New** project, click **File > New > Performance Analyzer** (Analyzer Only).

Last Saved Performance Analysis Project

To open the last saved Performance Analysis project, click the

Open Last Saved Performance Analyzer button.

2.10.2 Performance Analysis Project

The Performance Analyzer dialog opens.

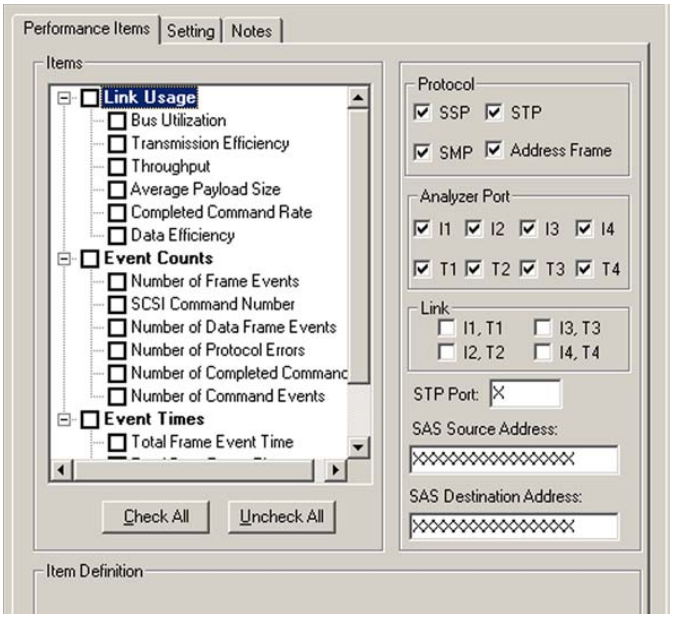


Figure 2.167: SAS: Performance Analysis Definition Dialog

Note: When you use the Exerciser, channel 2 is not usable and is greyed out.

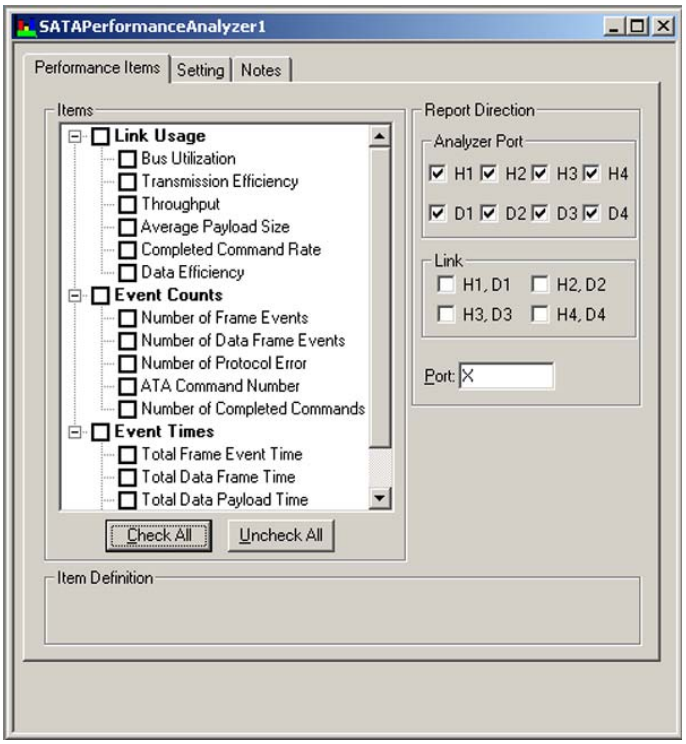


Figure 2.168: SATA: Performance Analysis Definition

Choose Protocol (SAS only)

Check the protocol check box(es) to select the protocol category:

- SSP for SCSI Commands
- STP for SATA Commands
- SMP for Management Commands
- Address Frame for Open and Identify

Analyzer Port

Check the Analyzer Port(s) to include in the performance calculation.

Link

Check the Link(s) to include in the performance calculation.

STP Port

Enter the STP port number for the STP port to include in the performance calculation.

SAS Source Address (SAS only)

Enter a SAS Source Address to include in the performance calculation.

SAS Destination Address (SAS only)

Enter a SAS Destination Address to include in the performance calculation.

Define Performance

Click the **Performance Item** check box in the Performance Items tab. Performance measurement has the following categories:

- Link Usage:
  - Bus Utilization (Ratio of frame time to update interval)
  - Transmission Efficiency (Ratio of payload time to frame time)
  - Throughput (Quantity of payload or useful data transferred during update interval)
  - Average Payload Size (Ratio of overall payload size to number of data frame)
  - Completed Command Rate (Ratio of completed commands to total commands)
  - Data Efficiency (Ratio of data payload time to data frame time)
- Event Counts:
  - Number of Frame Events
  - SCSI Command Number
  - Number of Data Frame Events
  - Number of Protocol Errors
  - Number of Completed Commands
  - Number of Command Events
- Event Times:
  - Total Frame Event Time
  - Total Data Frame Time
  - Total Data Payload Time
  - Total Idle Time

Settings

Click the **Setting** tab to display the settings dialog.

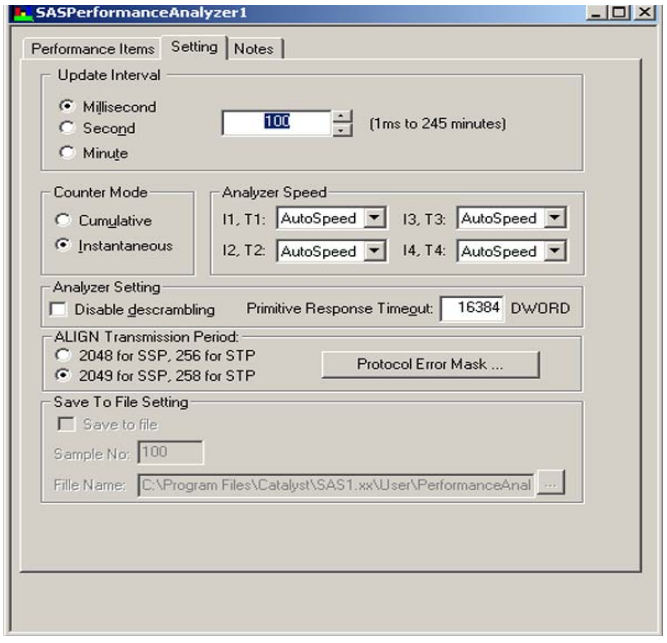


Figure 2.169: SAS: Settings Dialog

Note: When you use the Exerciser, channel 2 is not usable and is greyed out.

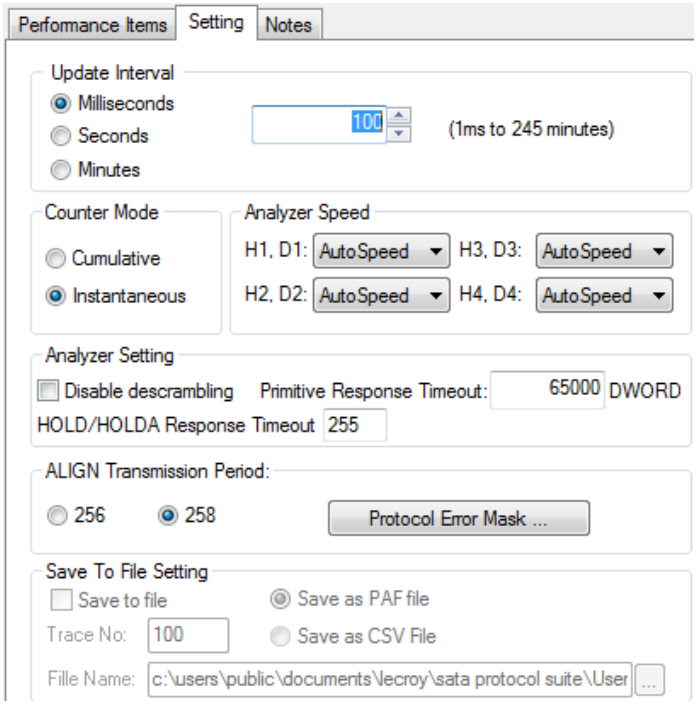


Figure 2.170: SATA: Settings Dialog

The settings dialog allows you to set the Analysis update interval and define the counter mode.

1. Choose the **Update Interval** in the range of 1 ms to 245 minutes.
2. Set the **Counter Mode** to either Cumulative or Instantaneous.
   Cumulative causes the measurement counters to continually increment>
   Instantaneous causes the measurement counters to reset for each Update interval.
3. Set the **Analyzer Speed** for each port used.
4. To disable descrambling, check the **Disable Descrambling** check box.
5. Enter a value for **Primitive Response Timeout**.
6. Choose the **Align Transmission Period** by checking the corresponding option button.
7. To select **Protocol Errors** to exclude from the analysis, click the **Protocol Error Mask** button and check any or all of the protocol errors to exclude. See “Protocol Errors” on page 68.
8. To save the analysis result for later review, check **Save to file** and enter the path in which to save the result.
9. To include a descriptive note about the project, click the **Notes** tab and enter information in the **Notes** dialog. See “Add a Project Note” on page 110.

To perform the Performance Analysis, click the **Run Hardware** button and wait for the real time analysis for the selected items to display.

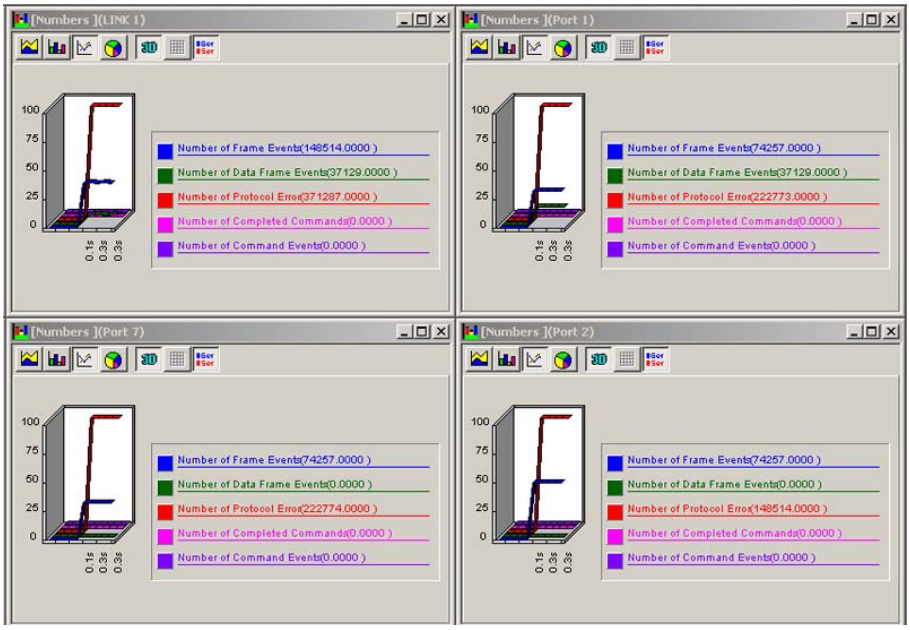

[Numbers](LINK 1)
Number of Frame Events(148514.0000)
Number of Data Frame Events(37129.0000)
Number of Protocol Error(371287.0000)
Number of Completed Commands(0.0000)
Number of Command Events(0.0000)
[Numbers](Port 1)
Number of Frame Events(74257.0000)
Number of Data Frame Events(37129.0000)
Number of Protocol Error(222773.0000)
Number of Completed Commands(0.0000)
Number of Command Events(0.0000)
[Numbers](Port 7)
Number of Frame Events(74257.0000)
Number of Data Frame Events(0.0000)
Number of Protocol Error(222774.0000)
Number of Completed Commands(0.0000)
Number of Command Events(0.0000)
[Numbers](Port 2)
Number of Frame Events(74257.0000)
Number of Data Frame Events(0.0000)
Number of Protocol Error(148514.0000)
Number of Completed Commands(0.0000)
Number of Command Events(0.0000)

Figure 2.171: SAS: Performance Analysis Real Time Display

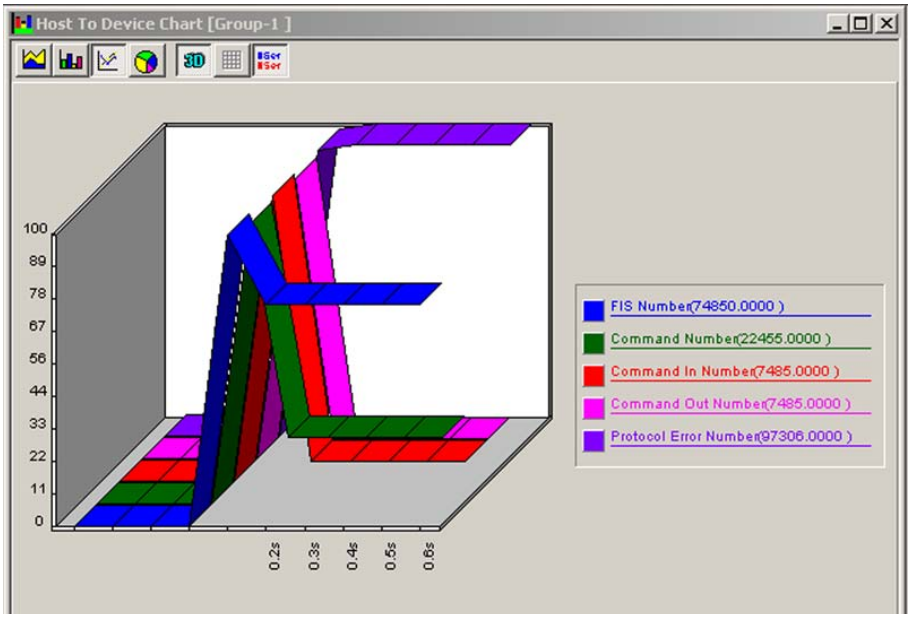
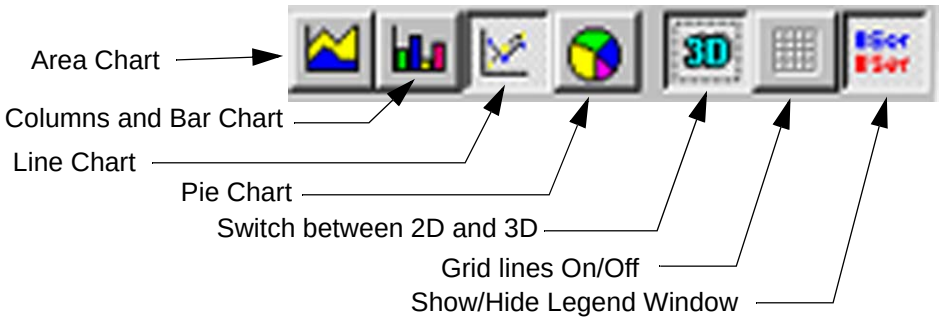

Host To Device Chart [Group-1]
FIS Number(74850.0000)
Command Number(22455.0000)
Command In Number(7485.0000)
Command Out Number(7485.0000)
Protocol Error Number(97306.0000)

Figure 2.172: SATA: Performance Analysis Results Display

Alternate Display Format

You can display the result as 2D, 3D, and so on, by clicking the corresponding **Graphics Setting** on the Performance Analysis toolbar.



2.11 Run Hardware

To perform the defined analysis, click the **Run Hardware** button and wait for the result to display**.**

2.12 Target and Device Emulation

You can run the analyzer while device emulation is active to monitor bus traffic.

2.12.1 Pages Tab

SAS: To set up SAS Target Emulation, click **File > New > Target Emulator** to display the target emulator with the Pages tab selected (see Figure 2.173 on page 173).

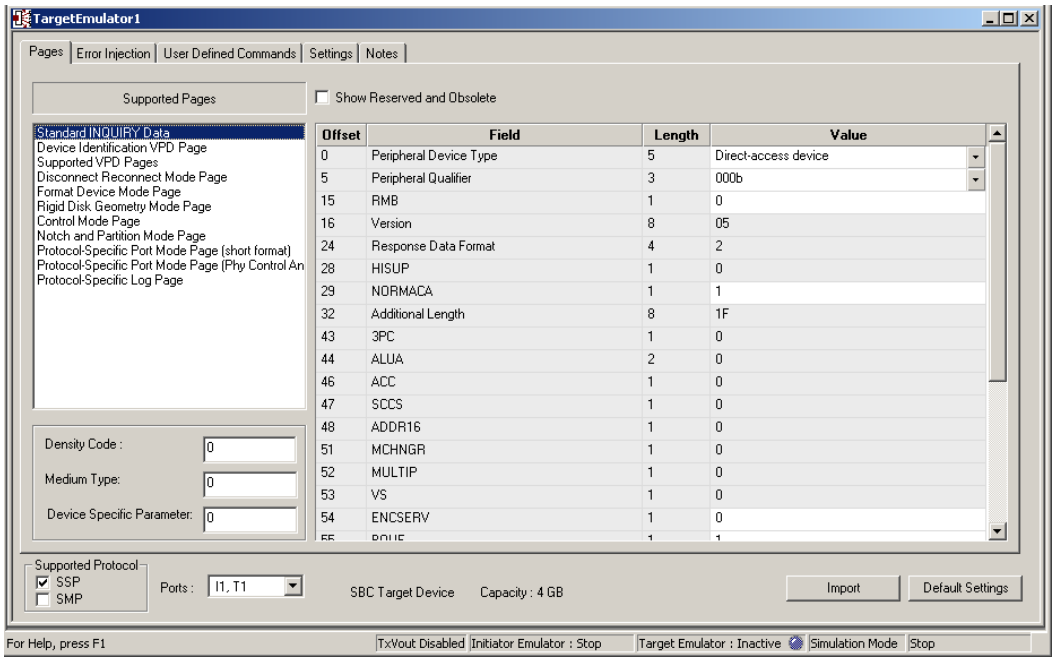


Figure 2.173: SAS: Target Emulation Project Pages Tab

The Target Emulator pages open with default settings for each page. To change settings for your application:

1. Select a page in the Supported Pages box and set values for each of the enabled (white) Value fields.
2. Enter values for Density Code, Medium Type, and Device Specific Parameter for the target emulator.
3. Check **SSP** or **SMP** to specify the protocol to support.
4. To reset the pages to the default settings, click the **Default Settings** button.
5. To use a previously defined Target, click the **Import** button and choose a previously defined Device Identifier *.saf file.

Note: Clicking the **Import** button on any of the Target Emulation dialogs sets all the parameters for the current emulation, including User-Defined Commands.

SATA: To set up a Device Emulation, click **File > New > Device Emulator**. The Device Emulation project opens with the Pages tab selected.

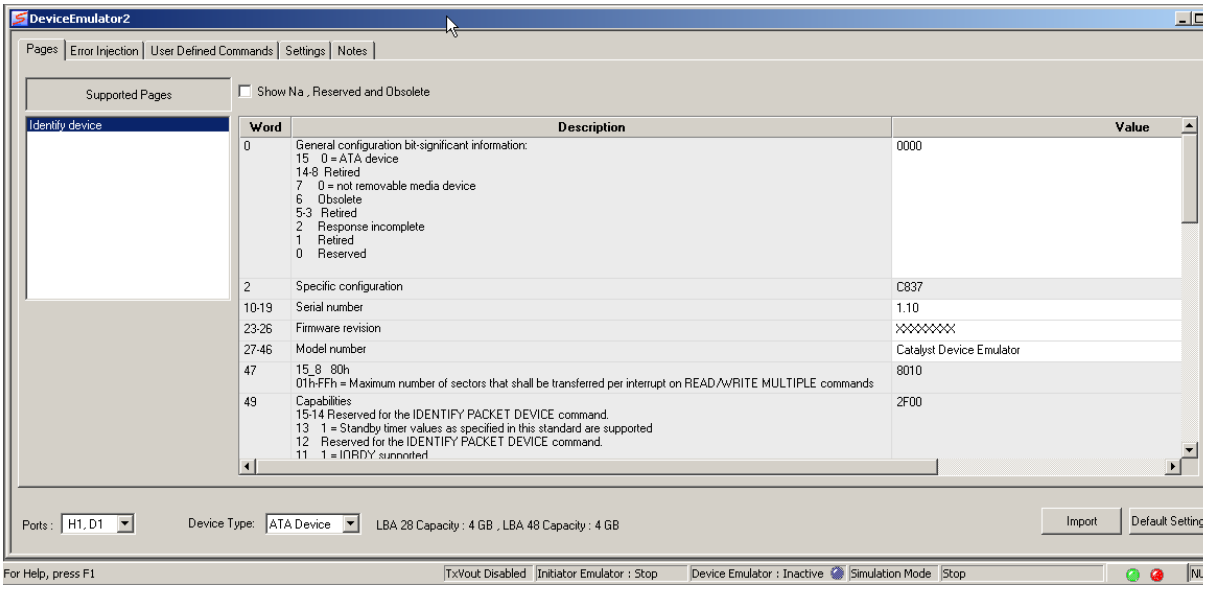


Figure 2.174: SATA: Device Emulation Project Pages Tab

The Device Emulator pages open with default settings for each page. To change settings for your application:

1. Set the Device Type of either ATA or ATAPI
2. Set values for each of the enabled (White) Value fields on the Identify page.
3. To reset the pages to the default settings, click the **Default Settings** button.

To use a previously defined emulation, click the **Import** button and select an emulation.

Words with Settable Bits

The table below lists the words with settable bits.

TABLE 2.1:

Word	Bit Numbers of Settable Bits
0	All
10-19	All
23-26	All
27-46	All
48	All
75	0, 1, 2, 3 and 4
76	14, 9, 8, 3, 2 and 1
77	7
78	8, 5, 4, 3, 2 and 1

TABLE 2.1:

Word	Bit Numbers of Settable Bits
79	7, 5, 4, 3, 2 and 1
82	0
83	10, 1, 0
84	7, 6, 1, 0
86	10, 1, 0
87	7, 6, 1, 0
100-103	All
106	12
117-118	All
215-216	All
255	All

Writable Buffer Size Field

The writable buffer size field is about 3.5 GB. The buffer is cyclical in that it behaves in a Circular Writable manner in the Host Emulator. Writing 500MB at address 00000000 and 1GB starting at address 00100000 still stores the contents of address 00000000. If you start writing 2GB at address 3G, the contents of address 00000000 are overwritten after 1G.

After writing data to the Device Emulator and disconnecting/reconnecting by clicking Start/Stop the data still remains in the Device Emulator.

Error Injection Tab

Clicking the **Error Injection** tab opens the General Errors dialog (see Figure 2.175 on page 176 and see Figure 2.176 on page 176).

SAS: In addition to specifying general errors, you can also set errors for Identify, Connection Management, and SAS Commands by clicking the corresponding icon in the Errors window.

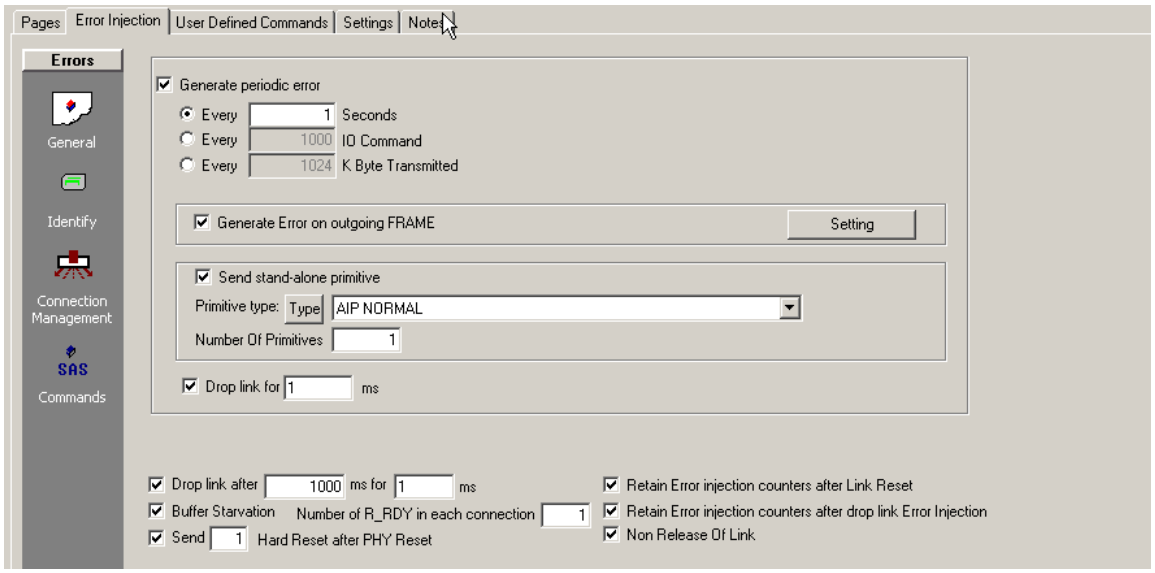


Figure 2.175: SAS: Setting General Errors

SATA: In addition to specifying general errors, you can also set errors for ATA Commands and SATA Signature by clicking the corresponding icon in the Errors window.

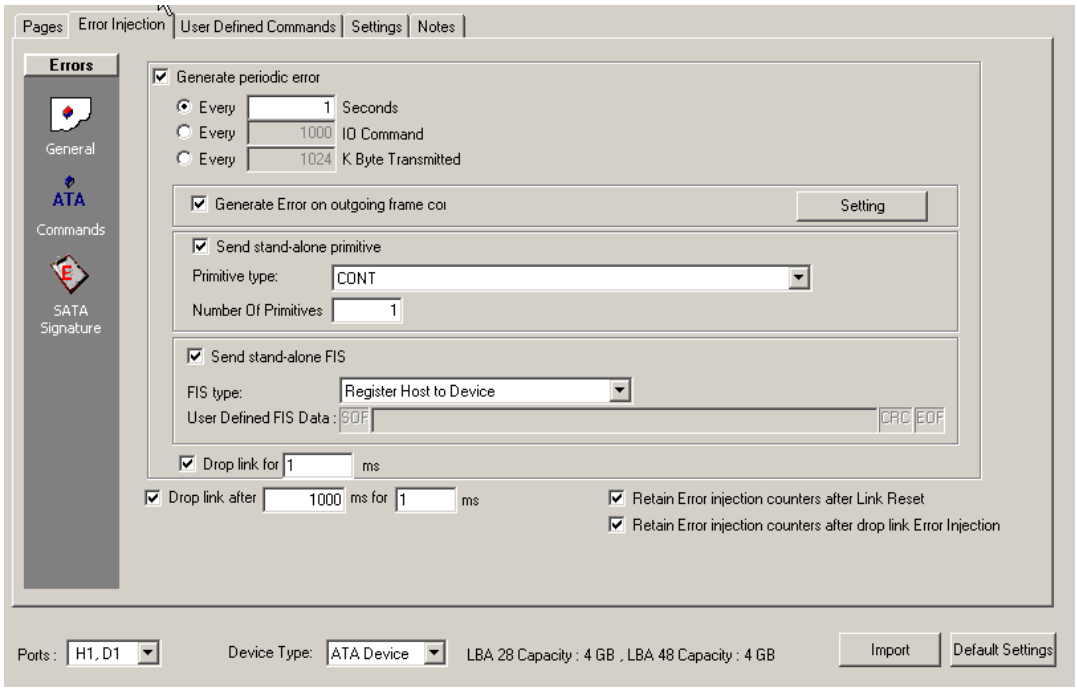


Figure 2.176: SATA: Setting General Errors

2.12.2 Setting General Errors

Generate Periodic Error

Generate Periodic Error allows you to inject periodic error on Command frame, FIS frame, stand alone primitive, and stand alone FIS. Check **Generate Periodic Error** and select the period unit of time, number of IO commands, or number of kilobytes transferred, by checking the corresponding option button.

Outgoing FIS Command Error or Outgoing FRAME Command Error

SAS: Check **Generate Error on outgoing FRAME**, then click the **Setting** button to open the error setting dialog.

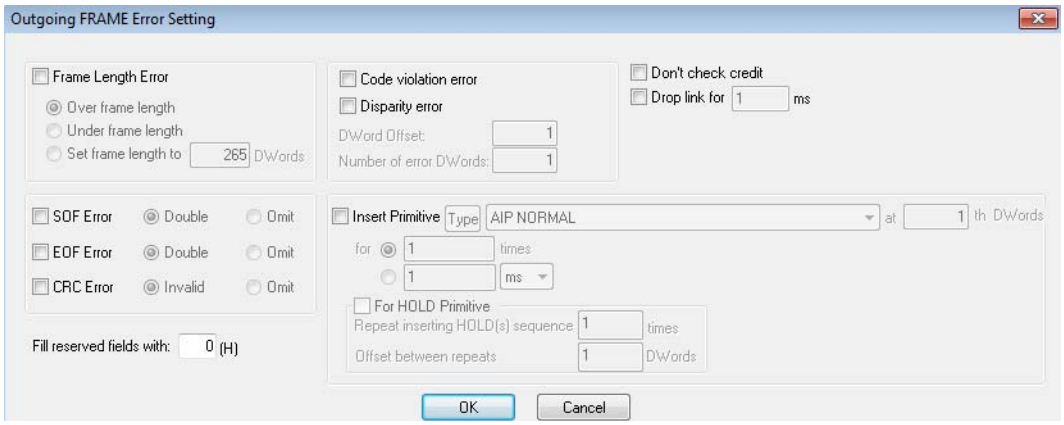


Figure 2.177: SAS: Outgoing Frame Error Setting

SATA: Check **Generate Error on outgoing frame commands**, then click the **Setting** button to open the error setting dialog.

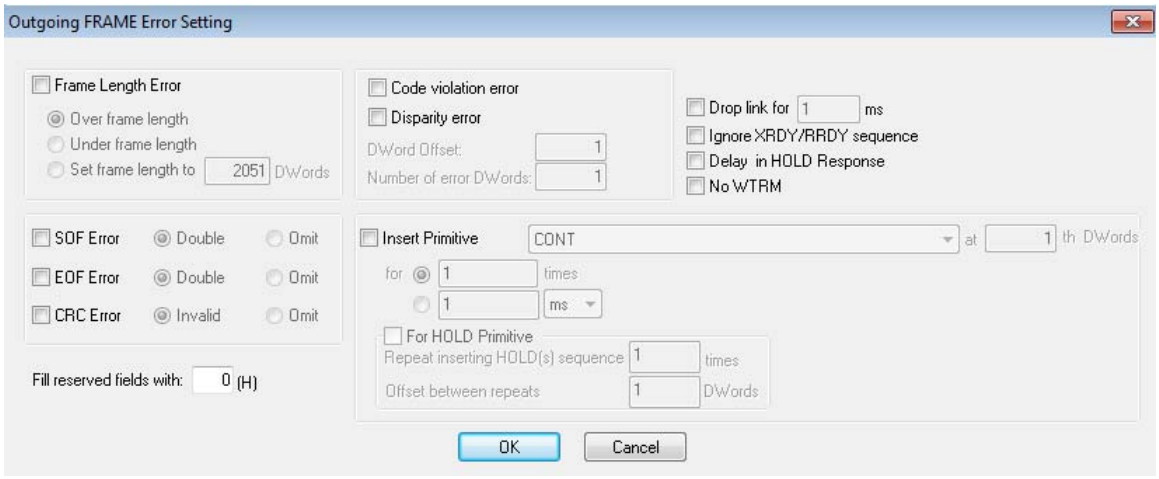


Figure 2.178: SATA: Outgoing FIS of Command Error Setting

Frame Length Error

Check Frame Length Error and choose the type of error to introduce.

- **Under frame length**: Data frame payload returned by the DE is 0 bytes.
- **Set data frame length to xxxx DWORDs**: Sets the frame length and not the payload length. You need to consider the frame header in the calculations.
- **Over frame length**: 2049 DWORD payloads are sent instead of 2048, because four 00 bytes are added to the payload.

Code violation and Disparity errors

Check these and specify the DWORD offset and the number of error DWORDs.

Don’t check credit (SAS only)

Check this to disable credit checking.

Value of Reserved Fields

Enter a value.

Ignore XRDY/RRDY sequence (SATA only)

Check or not.

Delay in HOLD Response (SATA only)

Check or not.

No WTRM (SATA only)

Check or not.

SOF, EOF & CRC Errors

Check any or all and choose the criteria for introduction.

Insert Primitive

Check Insert Primitive, click the Type button to open the Primitive Type dialog, then select the primitive type.

Send Primitive

Check **Send stand-alone primitive**, click the Type button to open the Primitive Type dialog, select the primitive type, and click **OK**.

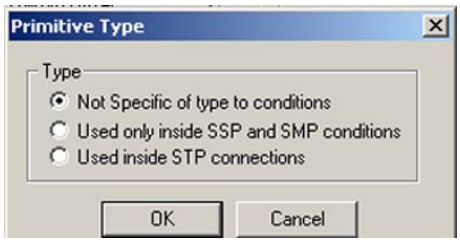


Figure 2.179: Primitive Type

Click the down arrow on the Primitive list box, choose a primitive, enter a value for the number of primitives to send, and click **OK**.

Drop link for ... ms

Check and enter time value for which to drop the link.

Drop link after ... ms for ... ms

Check and enter time value for which to wait before dropping the link and time value for which to drop the link.

Retain Error Injection Counters after Link Reset

If unchecked, after every Link Reset, the Emulator resets its internal Command Number/ Counters and re-initializes the Error injection core. If checked, the Emulator keeps the state.

Retain Error Injection Counters after drop link error injection

If unchecked, after every Link Reset, the Emulator resets its internal Command Number/ Counters and re-initializes the Error injection core. If checked, the Emulator keeps the state.

Buffer Starvation (SAS only)

Enter **Number of R_RND in each connection**.

Send ... Hard Reset after PHY Reset (SAS only)

Specify number of resets to send.

Send FIS (SATA only)

Check **Send stand-alone FIS**, select the FIS Type button, and optionally enter User Defined FIS Data.

Identify Errors (SAS only)

Click the **Identify** icon in the Errors window to display the Identify Error Setting dialog.

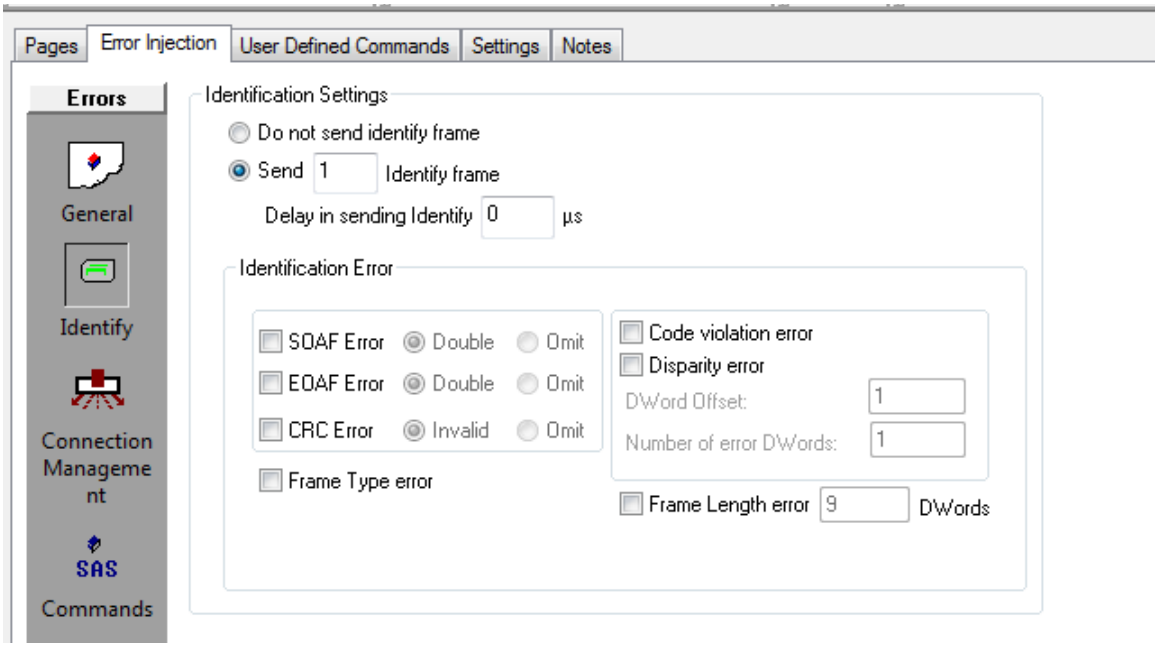


Figure 2.180: SAS: Identify Error Setting Dialog

Sending Identify Frame

Check the **Send** option button, then specify the number of Identify frames to send (and a delay, if needed).
Not to send Identify frames, check the **Do not send identify frames** option button.

Frame Type Error

Check this to send a Frame Type error.

Frame Length Error

Check **Frame Length error** and enter the number of DWORDs in the corresponding text box.

SOAF, EOAF and CRC

Check any or all and check the criteria for introduction.

Code violation and Disparity

Check either or both and specify DWORD offset and Number of DWORDs in the corresponding text boxes.

2.12.3 Connection Management (SAS only)

Click the **Connection Management** icon in the Errors window to display the Connection Management Setting dialog (Figure 2.181 on page 181).

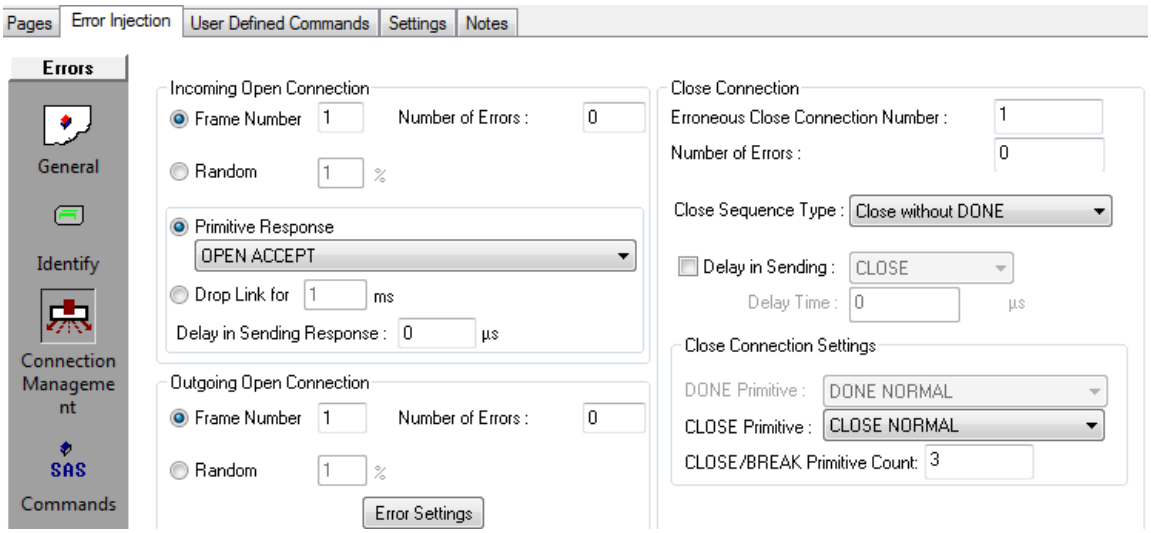


Figure 2.181: SAS: Connection Management Setting Dialog

Open Connection Definition

Incoming Frame Settings

1. In the **Open Connection** dialog, enter a value for the **Incoming Open Frame Number** and the **Number of Errors** in the corresponding text box**.**
2. Click the **Random** radio button if desired and enter a value.
3. Click the down arrow next to the **Primitive Response:** drop down list box, choose a primitive response, and enter a value for the **Delay in Sending Response** text box.
4. Click the **Drop Link for** radio button if desired and enter a value
5. Enter a value for **Outgoing Open Frame Number** and **Number of Errors** in the corresponding text box.

Outgoing Frame Settings

1. In the **Outgoing Open Connection** pane, enter a value for the **Frame Number** and the **Number of Errors** in the corresponding text box**.**
2. Click the **Random** radio button if desired and enter a value
3. Click **Error Settings** to display the **Open Frame Setting** dialog. Check the errors to introduce and click **OK**.

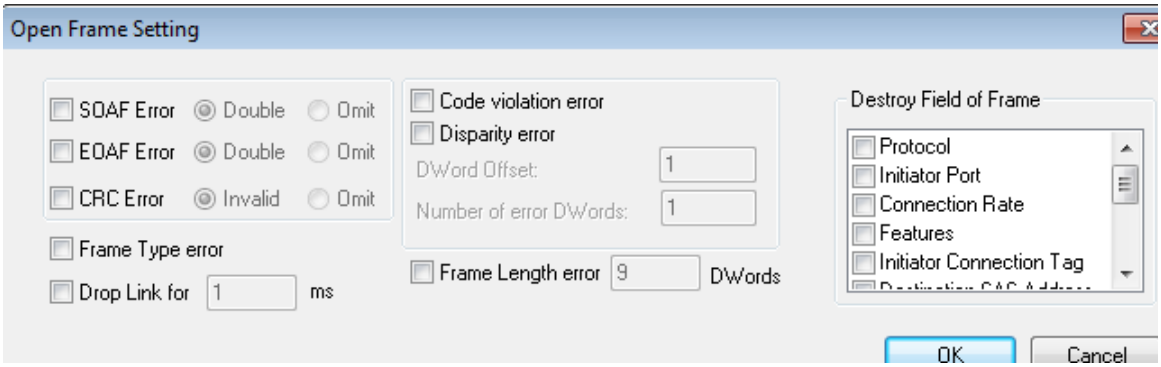


Figure 2.182: SAS: Open Frame Setting

Close Connection Definition

1. In the **Close Connection** dialog, enter a value for the **Erroneous Close Connection Number** and the **Number of Errors** in the corresponding text box.
2. Click the down arrow next to the **Close Sequence Type** drop down list box, then choose a closing sequence.
3. For a delay in sending, click the **Delay in Sending** check box, click the down arrow on the associated drop down list box, choose what to delay, and enter a value for the **Delay Time.**

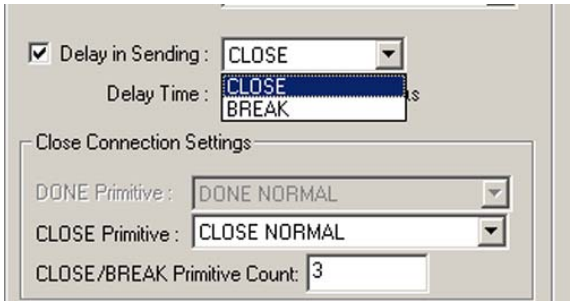


Figure 2.183: SAS: Delay in Sending

4. Click the down arrow on the **ClOSE Primitive** or **DONE Primitive** dropdown list box in the **Close Connection Settings** dialog, then choose a Close or Done Primitive.
5. Enter a value in the **CLOSE/BREAK Primitive Count** text box.

2.12.4 SAS Commands Errors (SAS only)

Click the **SAS Commands** icon in the Errors window to display the Commands Error Setting dialog.

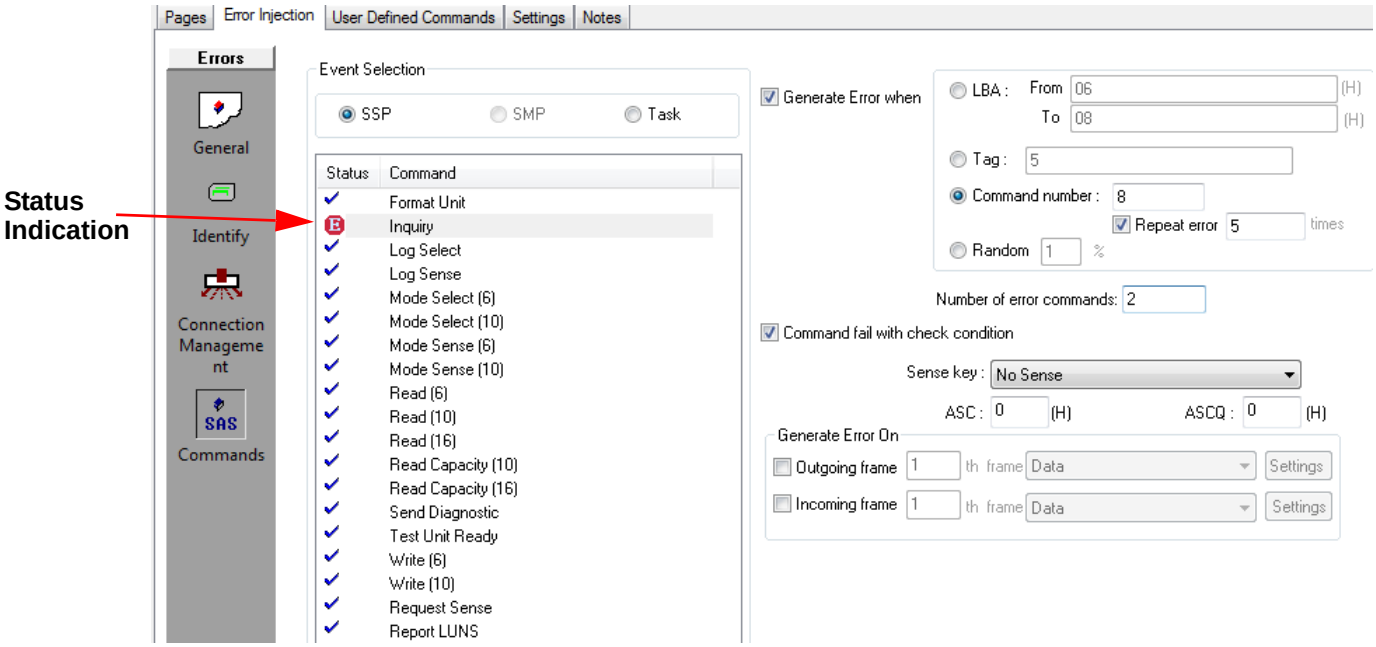


Figure 2.184: SAS: SAS Commands Error Setting Dialog

1. Click the **SSP, SMP** or **Task** option button to display the commands available for each of these categories in the Event Selection window.
2. Click a command for which to set an error, check the **Generate Error when:** check box, then enter values for **LBA, TAG,** or **Command number** in the corresponding text box.

Command number specifies the number of the command for which you want to inject error. For example, if you select the **Inquiry** command, then enter **2** for the Command Number, you inject error on the 2nd Inquiry command.

Number of error commands specifies the number of commands for which you want to inject error. For example, if you select the **Inquiry** command, then enter **2** for the Command Number, and enter **3** for Number of Error Commands, the target emulator injects error on the 2, 3, and 4 Inquiry commands, because you want to inject on 2nd command and continue error injection as much as 3 times.

When using Command Number as the Error Injection filter, you can repeat the erring-command sets by checking **Repeat error**. The default value is 1, which injects error only once, with no repeats. In the above example, the system injects error on the 2, 3, and 4 Inquiry commands and does not inject error for other commands.
If you enter 2 for Repeat Error, the system injects error on the 2nd, 3rd, 4th, 6th, 7th, and 8th commands.
If you enter 3 for Repeat Error, target emulator injects error on the 2nd, 3rd, 4th, 6th, 7th, 8th, 10th, 11th, and 12th commands.

If you set Repeat Error to 0, it means infinity, and the system injects error on the 2nd, 3rd, 4th, 6th, 7th, 8th, 10th, 11th, 12th, 14th, 15th, 16th, 18th, 19th, 20th, 22th, 23th, 24th, and so on commands.

Note: **Repeat error** resets the target emulator received command counter.

In the API, use the following functions:

- **ErInjSetSCSICommandGenerateError**: Enable error injection on a command. Specify Command Number and Number of Error Commands in the 4th and 6th parameters.
  See API reference manual (section 5.5.139, page 748).
- **ErInjSetSCSICommandRepeatedErrorOnCommandNumber (int nCommand, BOOL bEnable, short iCountOfRepeatedErrorsOnCommands)**:
  nCommand specifies SCSI command. See 6.52 SCSI Command type definition in the API manual.
  bEnable: TRUE means you want repeat error as much as iCountOfRepeatedErrorsOnCommands.

3. Click the **Command fail with check condition** check box, click the down arrow on the **Sense Key** drop down list box, choose an error type, and then enter values for **ASC** and **ASCQ** in the corresponding text boxes.

   Some Check Condition Sense Key and ASC/ASCQ values are (see Figure 2.185 on page 184):

   - 01, 1807 (soft error, RECOVERED DATA WITH ECC - DATA REWRITTEN)

- 0b, 1103 (aborted command, MULTIPLE READ ERRORS)
- 0b, 4b06 (aborted command, INITIATOR RESPONSE TIMEOUT)
- 04, 4100 (hardware errors, DATA PATH FAILURE)

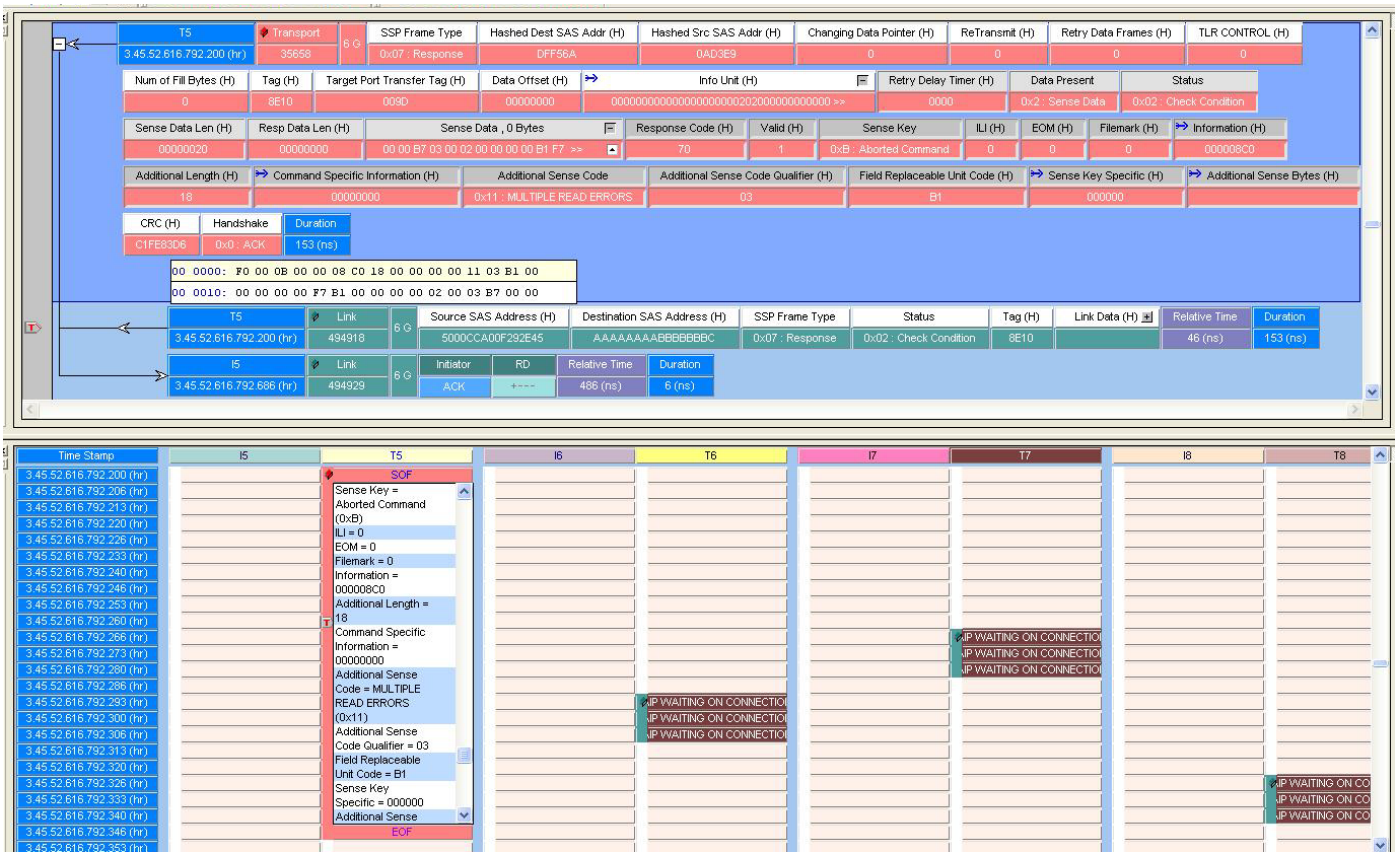


Figure 2.185: Sense Key Codes

4. Set up Outgoing and Incoming frame errors.

Note: Once you check the **Generate Error On:** check box for a command, a red status indication appears next to the command, indicating an error condition.

Outgoing Frame Settings

Before selecting Outgoing Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check **Outgoing Frame** in the Generate Error On area and then the enabled **Settings** button to display the Outgoing Frame Setting dialog. See Figure 2.186 on page 185.

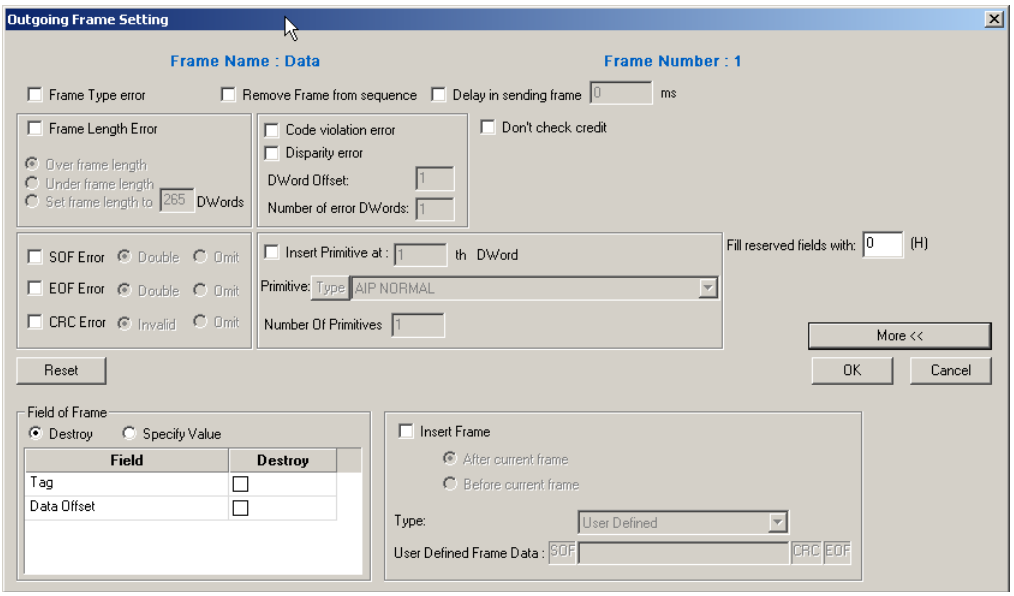


Figure 2.186: Outgoing Frame Setting Dialog

Frame Type Error

Check this to introduce a frame type error.

Remove Frame from sequence

Check this to remove frame from sequence.

Delay in sending frame

Check this to delay sending frame and enter a value for the delay.

Frame Length Error

Check Frame Length Error and choose the type of error to introduce.

Code Violation and Disparity error

Check these and specify DWORD offset and the number of error DWORDs.

Don’t check credit

Check this to disable credit checking.

SOF, EOF, and CRC errors

Check these and specify Double or Omit by checking the corresponding option button.

Insert Primitive

Check Insert Primitive, click the Type button to open the Primitive Type dialog, select the primitive type, and click OK.

Destroy Field of Frame

Make sure to click the More button and then check the field to destroy.

Insert Frame

Check Insert Frame, click the down arrow on the Type combo box, and choose the frame type. Make sure that you have clicked More.

Incoming Frame Settings

Before selecting Incoming Frame Settings, select the **Types Of Frames** and the **Frame Number** on which to inject an error. Then check **Incoming Frame** in the Generate Error On area and then the enabled **Settings** button to display the Incoming Frame Settings dialog.

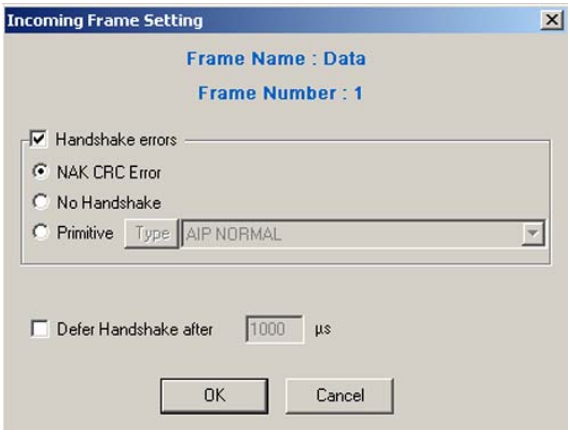


Figure 2.187: Incoming Frame Setting Dialog

Handshake Error

Check Handshake Errors to enable selection of error on handshake. Check NAK, CRC, or any other Primitive to send as an incoming frame response. Check No Handshake to send no response.

Defer Handshake Errors

Check **Defer Handshake** and enter a value for the time to defer the handshake.

2.12.5 ATA Commands Errors (SATA only)

Click the **ATA Commands** icon in the Errors window to display the ATA Commands Error Setting dialog.

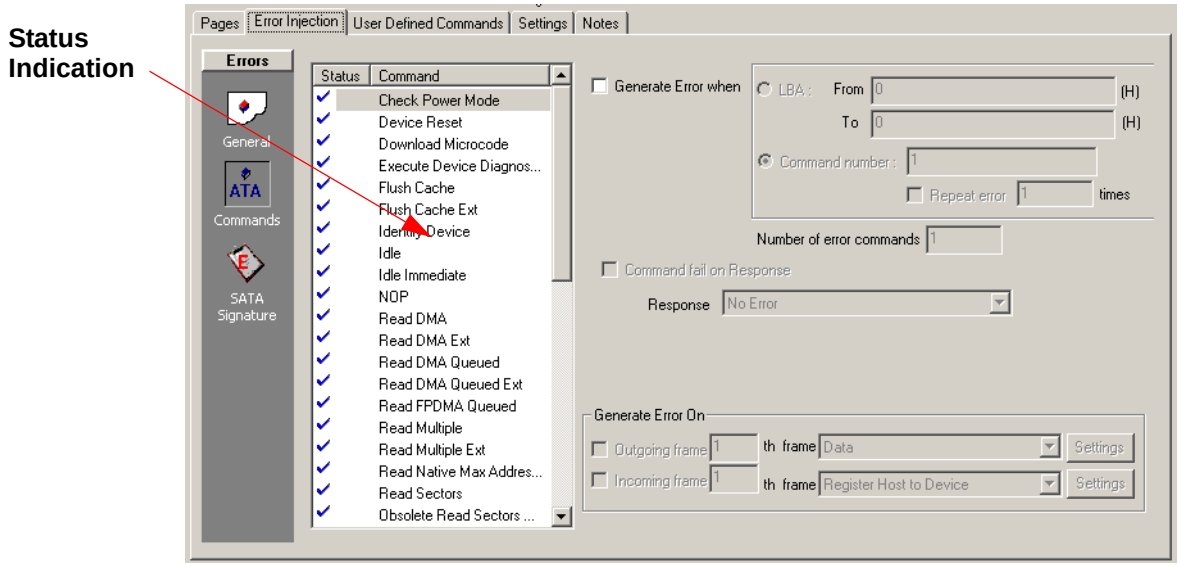


Figure 2.188: SATA: Commands Error Setting Dialog

To set errors for ATA commands:

1. Click a command for which to set an error and then check the **Generate Error when** check box and chose **LBA or Command number** with a value in the corresponding text box.

Note: Hard-drive password security commands (as described in ATA8) are Data Set Management, Write Uncorrectable Ext, Security Disable Password, Security Erase Password, Security Erase Unit, Security Freeze Lock, Security Set Password and Security Unlock.

2. When you choose Command Number, you can use **Repeat error** for periodic series of errors in commands. Set the number of times to repeat the error, by entering a value in the **Number of Error Commands** text box.

Note: Once you check the **Generate Error when:** check box for a command, a red status indication appears next to the command selected indicating an error condition.

3. To force the system to send a defined response frame to the host, check the **Command fail on Response** check box and then choose a pre-defined response.
4. Repeat for every command for which to set an error.

2.12.6 Outgoing Frame Settings

Before selecting Outgoing Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check **Outgoing Frame** in the **Generate Error On** area and then the enabled **Settings** button to display the Outgoing Frame Setting dialog.

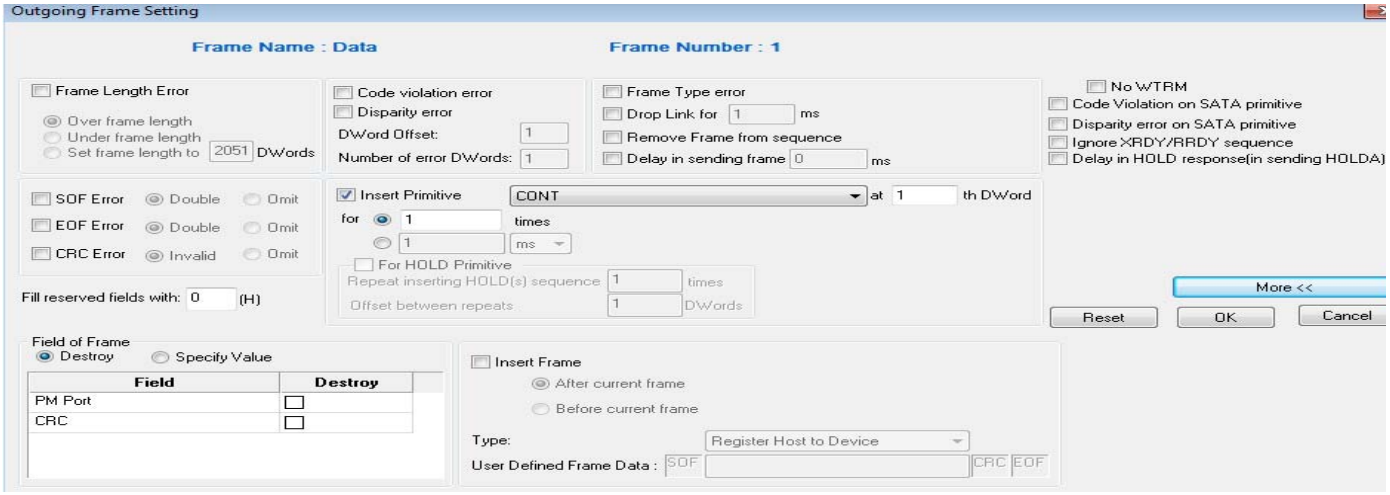


Figure 2.189: Outgoing Frame Setting Dialog

Frame Type Error

Check this to introduce a frame type error.

Drop Link for

Check this to drop link for specified duration.

Remove Frame from sequence

Check this to remove frame from sequence.

Delay in sending frame

Check this to delay sending frame and enter a value for the delay.

Additionally check:

- No WTRM
- Code Violation on SATA primitive
- Disparity error on SATA primitive
- Ignore XRDY/RRDY sequence
- Delay in HOLD response (in sending HOLDA)

Frame Length Error

Check **Frame Length Error,** choose the type of error to introduce and click **OK**.

Code violation and Disparity error

Check these and specify DWORD offset and the number of error DWORDs.

SOF, EOF and CRC errors

Check these and specify **Double** or **Omit** by checking the corresponding option button.

Insert Primitive

Check **Insert Primitive** to enable the Primitive Type dialog, select the primitive type and number of primitives, and click **OK**.

Destroy Field of Frame

Click the **More** button to display the Field of Frame area, check **Destroy,** and check the fields to destroy. Alternatively, check **Specify Value** to choose from a predefined list of values.

Set Value of Field

Check **Fill Out** in the **Field of Frame** area and enter values for fields.

Insert Frame

Check **Insert Frame** and then click the down arrow on the **Type** combo box and choose the frame type. Make sure that you have clicked **More.**

Note: In addition to the pre-defined frame types, you can scroll down the list to **User Defined** and then enter your own frame data between SOF and EOF.

2.12.7 Incoming Frame Settings

Before selecting Incoming Frame Settings, select the Types Of Frames and the Frame Number on which to inject an error. Then check **Incoming Frame** in the **Generate Error On** area and then the enabled **Settings** button to display the Incoming Frame Settings dialog.

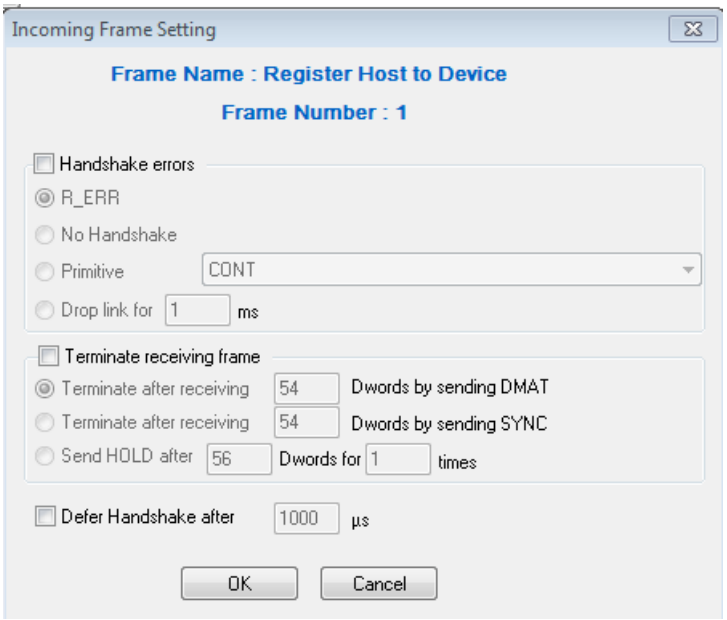


Figure 2.190: Incoming Frame Setting Dialog

Handshake Errors

Check **Handshake Errors** to enable selection of error on handshake. Check NAK, CRC, or any other **Primitive** to send as an incoming frame response. Check **No Handshake** to send no response.

Defer Handshake Errors

Check **Defer Handshake** and enter a value for the time to defer the handshake.

Primitive

Check **Insert Primitive** then click the down arrow on the **Primitive** drop down combo box and choose a primitive.

Terminate receiving frame

Check **Terminate receiving frame** and choose the termination condition.

2.12.8 SATA Signature (SATA only)

Click the **SATA Signature** icon in the Errors window to display the SATA Signature dialog.

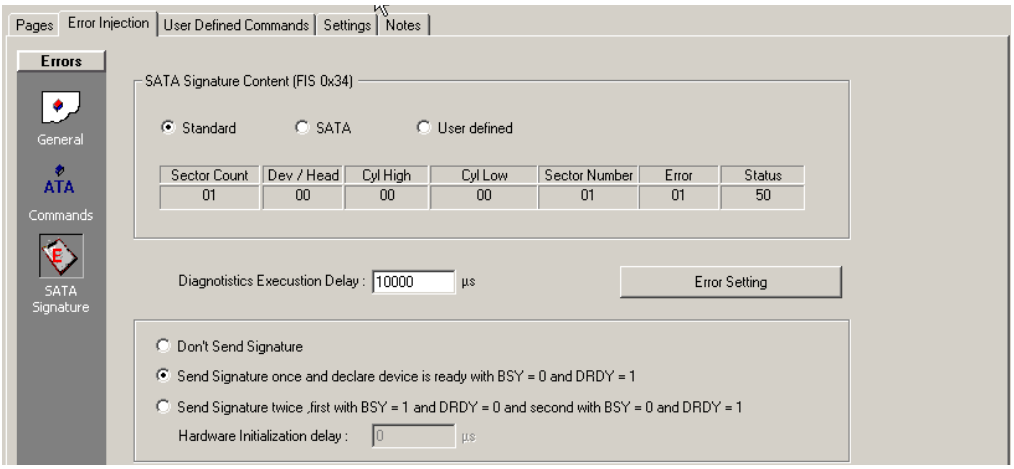


Figure 2.191: SATA: SATA Signature Dialog

Choose SATA Signature Content

Choose either the pre-defined **Standard** or **SATA**. Alternatively, you can define your own signature by checking the **User Defined** option button and then entering values in the enabled fields.

Specify when to send Signature

You can choose from **Don't Send Signature, Send Signature once** and declare device is ready with BSY=0 and DRDY=1, or **Send Signature twice**, first with BSY=1 and DRDY=0 and second with BSY=0 and DRDY=1, by checking the corresponding option button.

Note: If you choose **Send Signature twice**, first with BSY=1 and DRDY=0 and second with BSY=0 and DRDY=1, the system enables the Hardware initialization delay text box, allowing you to set the hardware initialization delay.

2.12.9 SATA Signature Errors

You can define errors to introduce when sending a SATA Signature. To define the errors, click the **Error Setting** button to open the SATA Signature Error Setting dialog.

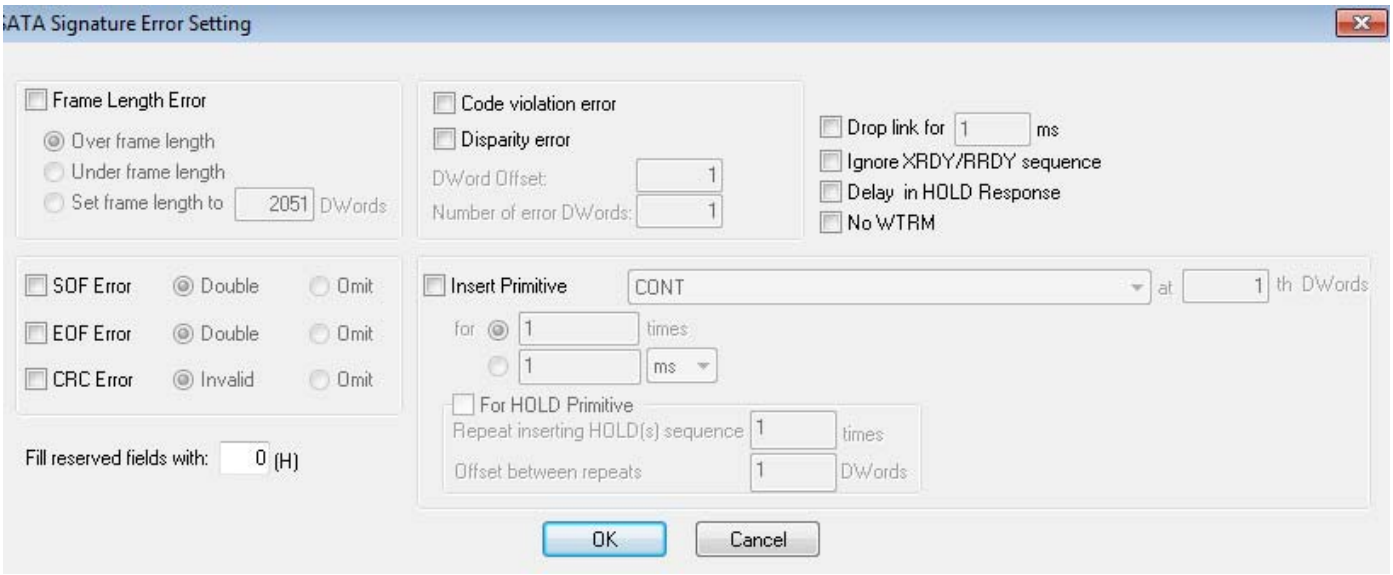


Figure 2.192: SATA: SATA Signature Error Setting

Frame Length Error

Choose the Frame Length Error type to introduce.

SOF, EOF and CRC Errors

Check any or all and check the criteria for introduction.

Code Violation and Disparity errors

Check and specify DWORD offset and Number of DWORD errors for Disparity error.

Additional Settings

Set and check:

- Value for Reserved fields
- Ignore XRDY/RRDY Sequence
- Delay in HOLD Response
- No WTRM

Insert Primitive

Check **Insert Primitive**, click the down arrow on the **Primitive** list box, choose a primitive type and enter a value for the Number of Primitive.

2.12.10 User-Defined Commands Tab

To create command(s) specifically for your application, click the **User Defined Commands** tab to display the command definition dialog.

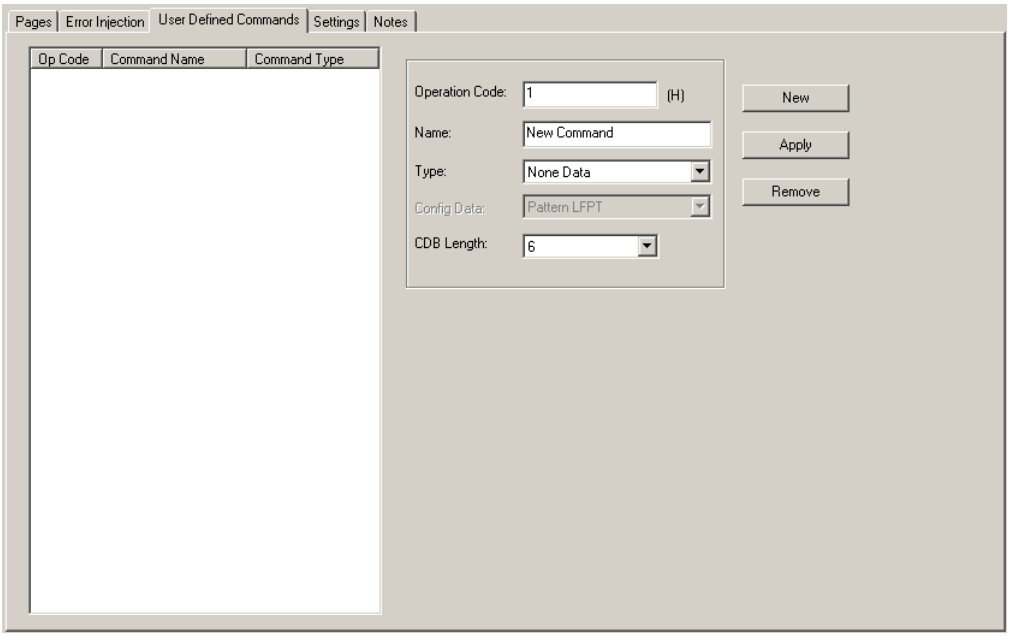


Figure 2.193: SAS: Command Definition Dialog

To define a command:

1. Enter an **Operation Code** and a **Name** in the corresponding text boxes.
2. Click the down arrow on the **Type** combo box and choose a command type.
3. For command types requiring configuration data, click the down arrow on the enabled **Config data:** combo box and choose appropriate configuration data.
4. Enter the **CDB length**: 6, 10, 12, or 16.
5. When done, click the **New** button.
6. The defined command appears in the command name window.
7. To make changes to a previously defined command, highlight the command, make the changes, and click **Apply.**

Note: After creation, the User-Defined commands appear in the Event Selection dialog.

2.12.11 Target Emulator Settings (SAS)

Click the **Settings** tab to display the Target Emulator Settings dialog.

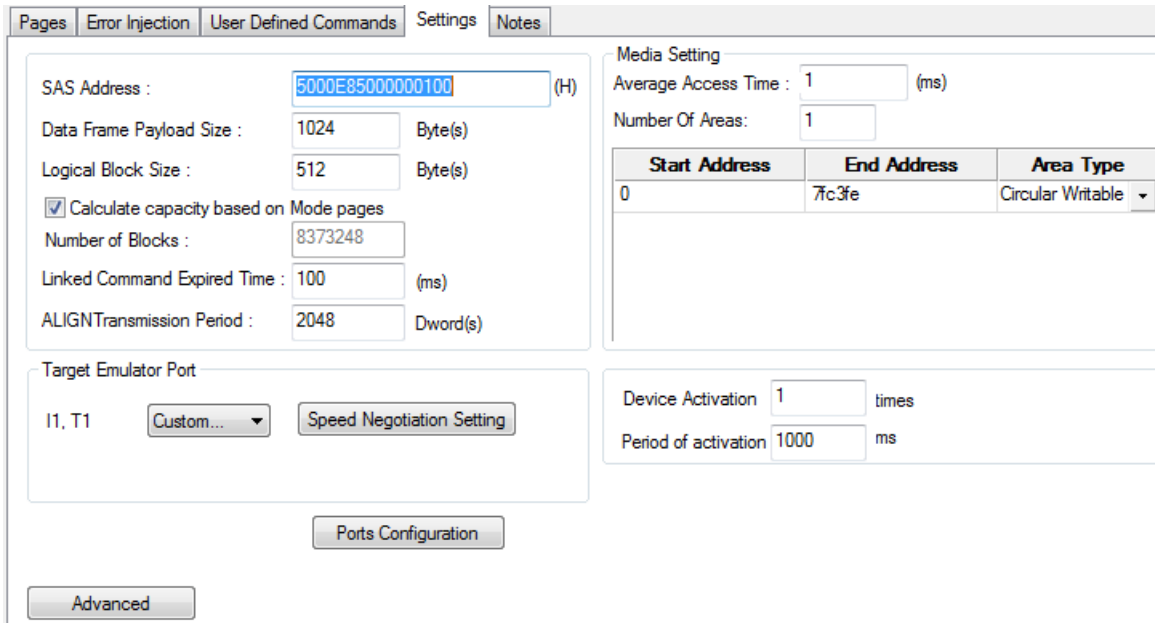


Figure 2.194: SAS: Target Emulator Settings Dialog

The Settings page opens with a default set of values, which you can modify. To return to these values, click the **Default Settings** button.

Define the Target

Enter a **SAS Address, Data Frame Payload Size, Logical Block Size, Linked Command Expired Time**, and **ALIGN Transmission Period** in the corresponding text box. Check **Calculate capacity based on Mode pages** or **enter a value for Number of Blocks**.

Media Settings

Enter a value for Average Access Time to simulate Seek/Access time delay of a real device.

Enter a Number of Writable Areas. **Define a Start** and an **End Address,** click the down arrow under the **Area Type**, and choose **Normal Writable, Circular Writable**, or **Non-Writable**.

Note: To set and get the settings of Media Settings Area Types, use these two functions:

```
SetMediaAreaAttribute(int nAreaIndex, int nStartAddress,
int nEndAddress, TrgEmulMediaAreaTypeEnum eAreaType, int* pnErrorCode)
GetMediaAreaAttribute(int nAreaIndex, int* pnStartAddress,
int* pnEndAddress, TrgEmulMediaAreaTypeEnum* peAreaType)
```

nAreaIndex: Specifies the (zero base) index of the Area.

Note: The Number of Areas should be set by the **SetNumberOfMediaArea** function prior to calling these functions.

---

nStartAddress: Specifies the start address of the Area.

nEndAddress: Specifies the End address of the Area.

eAreaType: Specifies the Area Type. This parameter should be in **TrgEmulMediaAreaTypeEnum** format. Its possible values are:

```
typedef enum {eNORMAL_WRITABLE = 0, eCIRCULAR_WRITABLE = 1,
eNONE_WRITABLE = 2} TrgEmulMediaAreaTypeEnum;
```

Choose Target Emulator Port

Click a port option button, then click the **Speed Negotiation Setting** button (see "Speed Negotiation Tab" on page 155). Select the port speed settings, all by default.

Ports Configuration

Click the **Port Configuration** button to display the Ports Configuration dialog (see "Ports Configuration" on page 106).

Device Activation

Enter a number of times in the **Activate Device** field. If **Activate Device** = 1, the software activates Target Emulator until you deactivate it. This is the default behavior. (**Period of Activation** has no effect.)

If **Activate Device** = n, where n > 1, the software activates and deactivates Target Emulator n times, with activation period specified in the **period of activation** field. For example, if **Activate Device** = 10 and **period of activation** = 2000 ms, the software activates Target Emulator for 2000 ms and then deactivates it, and then repeats activation and deactivation 9 times, for a total of 10 times. (You must enter **Period of Activation**.)

Advanced Settings

Click the **Advanced** button to display Advance Target Setting dialog for additional setting options. The dialog opens displaying the OOB Signal Setting tab.

OOB Signal Setting

Edit the default values displayed in the white editable fields.

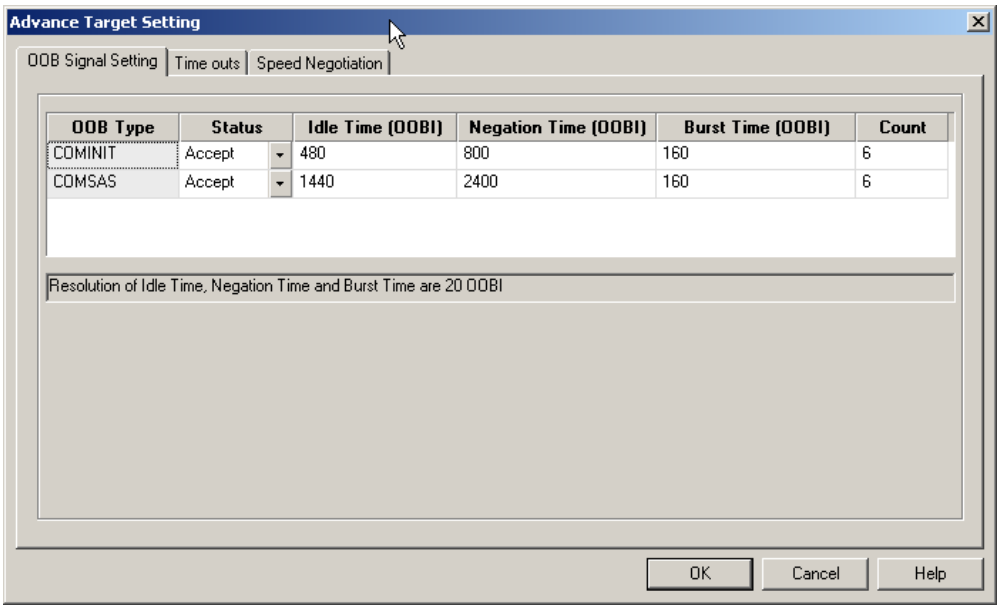


Figure 2.195: OOB Signal Setting Dialog

Set Timeouts

Click the **Timeouts** tab to display the Timeouts setting dialog.

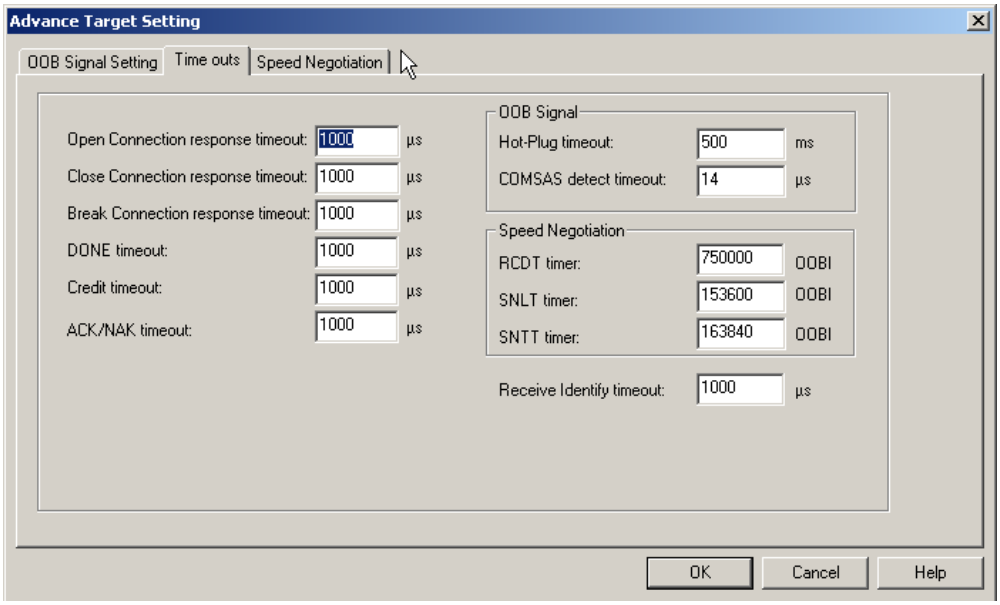


Figure 2.196: Timeout Setting Dialog

Edit the default values displayed in the white editable fields and click **OK**.

Set Speed Negotiating Error

Click the **Speed Negotiation** tab to display the Speed Negotiation dialog.

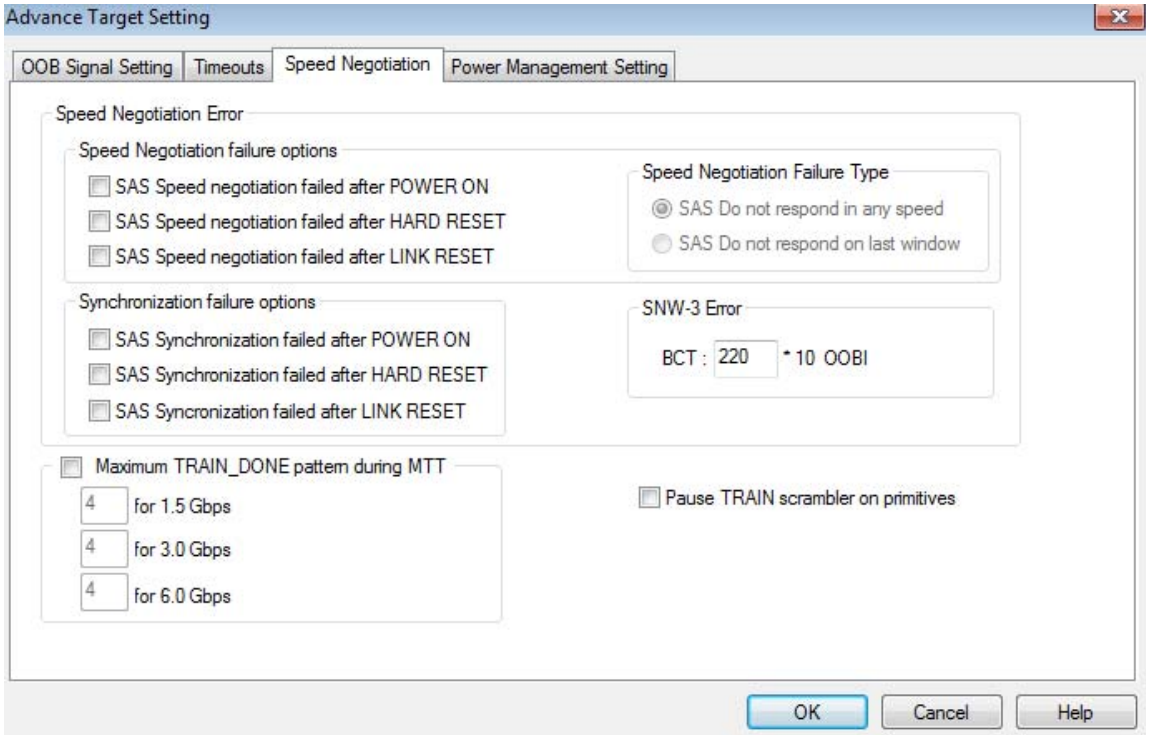

Advance Target Setting
OOB Signal Setting
Timeouts
Speed Negotiation
Power Management Setting
Speed Negotiation Error
Speed Negotiation failure options
SAS Speed negotiation failed after POWER ON
SAS Speed negotiation failed after HARD RESET
SAS Speed negotiation failed after LINK RESET
Speed Negotiation Failure Type
SAS Do not respond in any speed
SAS Do not respond on last window
Synchronization failure options
SAS Synchronization failed after POWER ON
SAS Synchronization failed after HARD RESET
SAS Syncronization failed after LINK RESET
SNW-3 Error
BCT : 220 * 10 OOBI
Maximum TRAIN_DONE pattern during MTT
4 for 1.5 Gbps
4 for 3.0 Gbps
4 for 6.0 Gbps
Pause TRAIN scrambler on primitives
OK
Cancel
Help

Figure 2.197: Speed Negotiating Error Setting Dialog

Check a **Speed Negotiation Error** check box and choose a failure type by checking a corresponding option button. Additionally, you can choose the **Synchronization failure** option.

Power Management Setting

Use the Power Management tab to manage power settings. Enter the relevant information in the Host Initiated Power Management and Device Initiated Power Management panes.

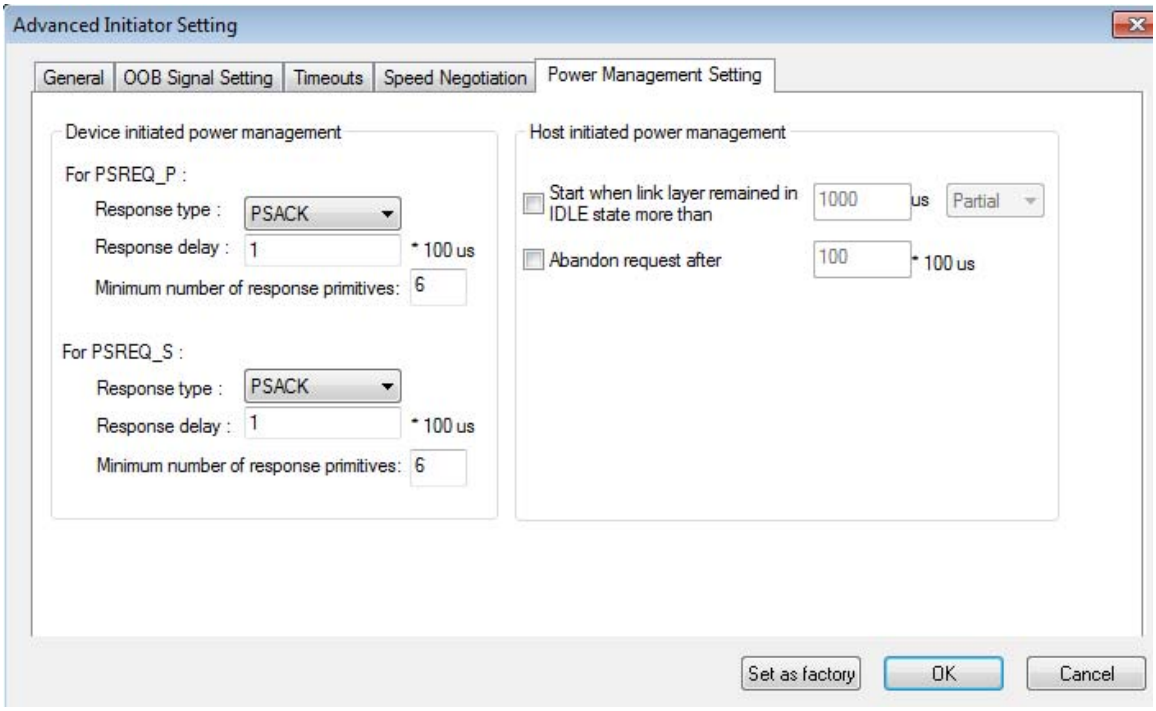


Figure 2.198: Power Management Tab

2.12.12 Notes Tab

Click the **Notes** tab and enter a Project Name and a brief description of the Target Emulation project (see "Add a Project Note" on page 110).

2.12.13 Run Target Emulation

Click the **Activate Device** button or select **Project Setup > Active Device** to start emulation.

Note: You can run the analyzer while device emulation is active to monitor bus traffic.

2.12.14 Device Emulator Settings (SATA only)

Click the **Settings** tab to display the Device Emulator Settings dialog.

The Settings tab opens with a default set of values, which you can modify. To return to these values, click the **Default Settings** button.

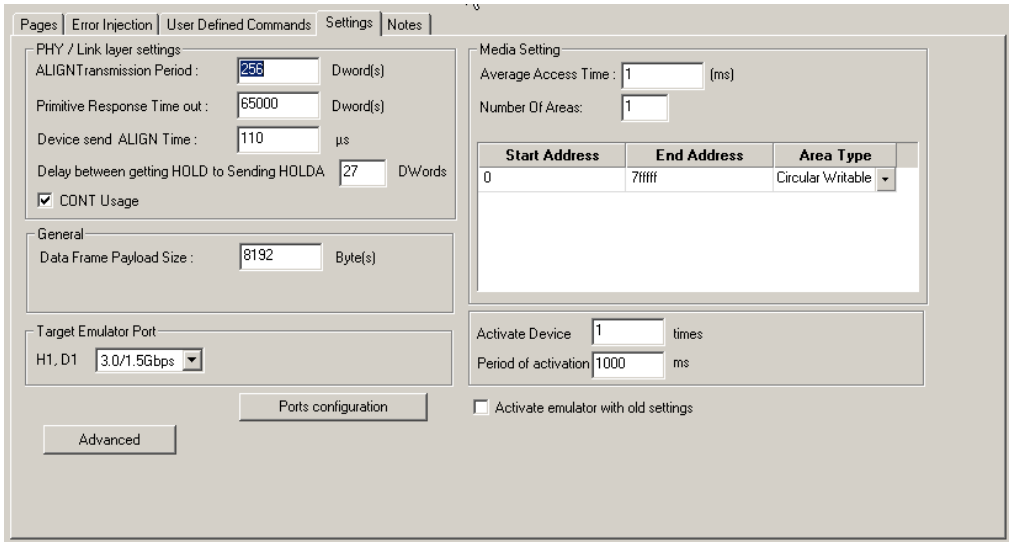


Figure 2.199: SATA: Device Emulator Settings

PHY/Link layer settings

Enter values for **Align Transmission Period**, **Primitive Response Timeout**, and **Standby Timeout**, **Device send Align Time** and **Delay between getting HOLD to Sending HOLDA** and specify a delay. Check **CONT usage**.

Delay Between Getting HOLD to Sending HOLDA

To enable the **Delay between getting HOLD to Sending HOLDA** feature perform the following steps:

1. Enter the value in the **Delay between getting HOLD to Sending HOLDA** field in the **Settings** tab as shown in the figure above.
2. Select the **Error Injection** tab (see Figure 2.200 on page 199.)

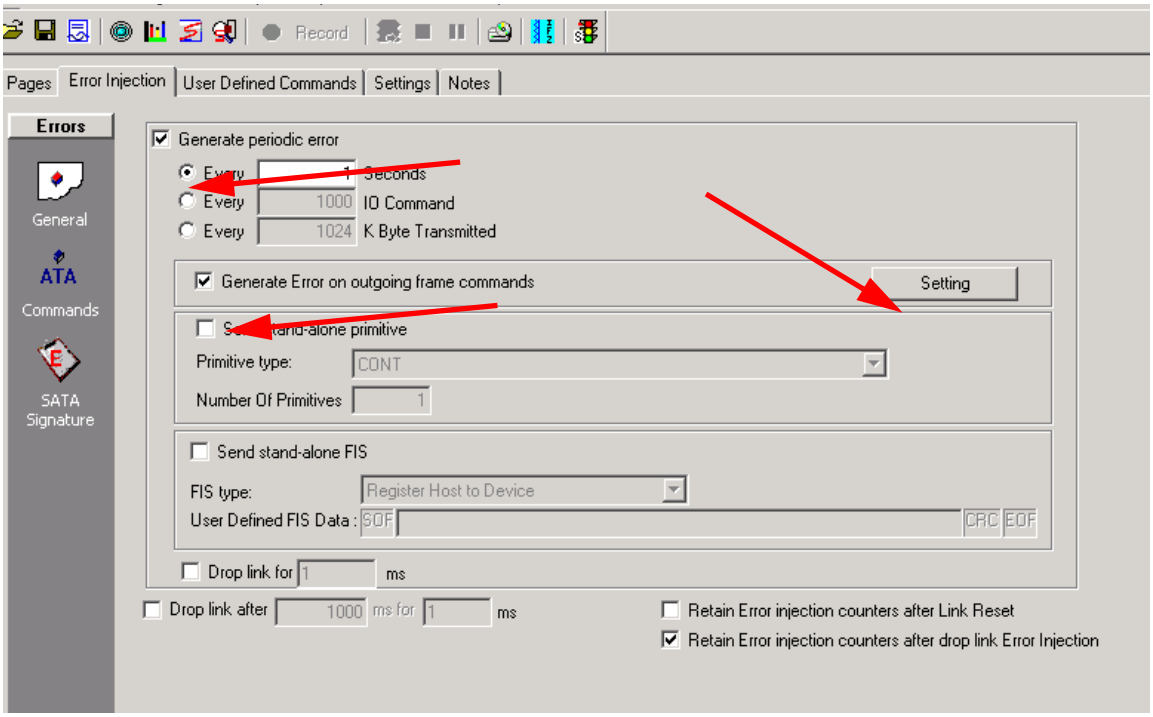


Figure 2.200: SATA: Error Injection Tab

3. Click the **Generate periodic error** check box.
4. Click the **Generate Error on outgoing frame commands** check box.
5. Click the **Settings** button.
   The Outgoing FRAME Error Setting dialog displays (see Figure 2.201 on page 199.)

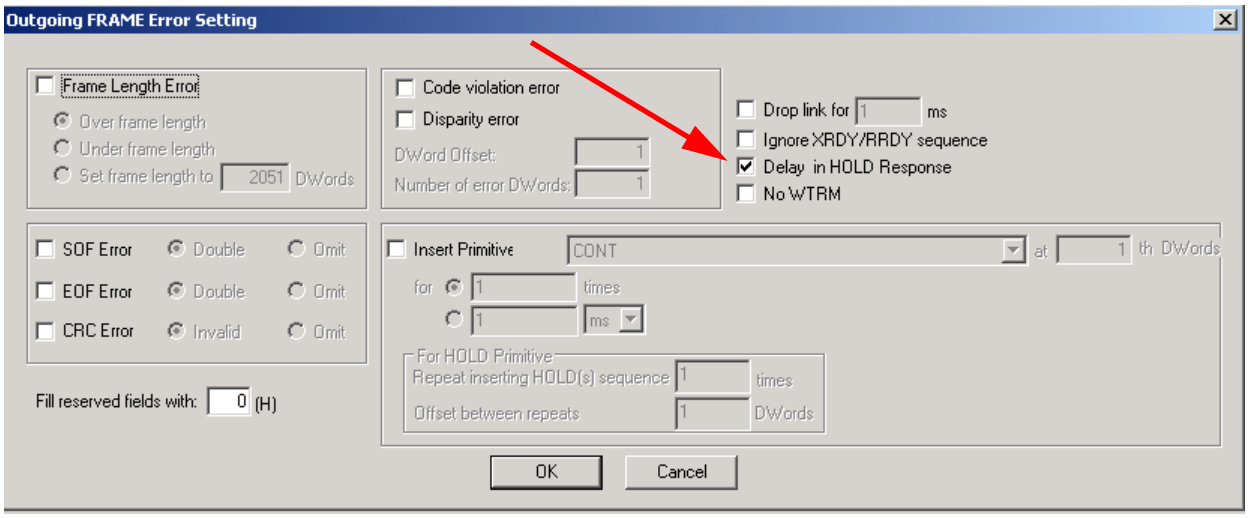


Figure 2.201: SATA: Outgoing FRAME Error Setting Tab

6. Click the **Delay in HOLD Response** check box.
7. Click **OK**.

Media Settings

Enter a value for **Average Access time** to simulate Seek/Access time delay of a real device.

Enter a **Number of Areas.** Define a **Start** and an **End Address**, click the down arrow under the **Area Type** and choose **Normal Writable**, **Circular Writable,** or **Non Writable**.

Payload Size

Enter a value for **Data Frame Payload Size** in the General area.

Choose Target Emulator Port

Click a port option button and click the down arrow next to the **Speed** list box and choose a port speed. Use the **Speed Negotiation Setting** button to open the dialog (see "Speed Negotiation Tab" on page 155).

Note: If you have made some changes to a defined emulation and want to return to the original definition, check the **Activate the emulator with old settings**.

Ports Configuration

Click the **Port Configuration** button to display the Ports Configuration dialog (see "Ports Configuration" on page 106).

Activation

Enter **number of times** and **period of activation**.

Advanced Options

Click the **Advanced** button to display the OOB Signal Setting, Power Management setting, Speed Negotiation, NCQ Command setting and Miscellaneous additional setting dialogs.

OOB Signal Setting

Edit the default values displayed in the white editable fields (see Figure 2.202 on page 201).

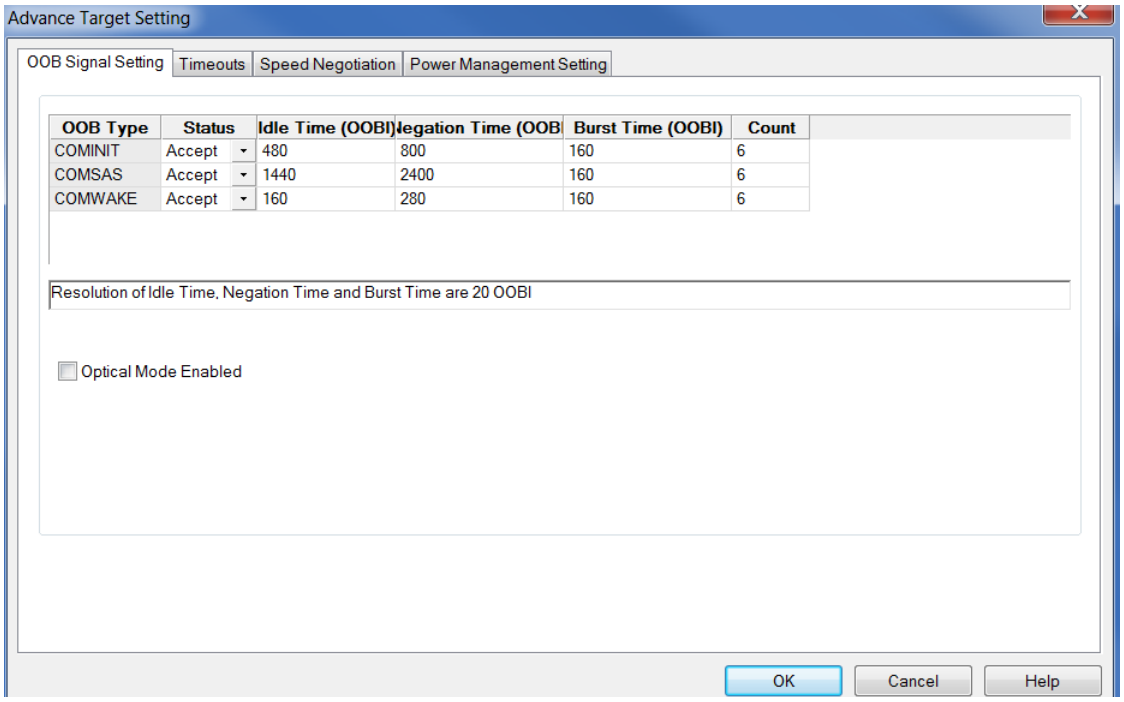


Figure 2.202: OOB Signal Setting Dialog

Timeouts

Click the **Timeouts** tab in the Advanced Host Setting dialog to specify timeouts for connection, CREDIT, ACK/NAK, ATA Command, OOB Signal and Identify frame.You can also edit the speed negotiation parameters.

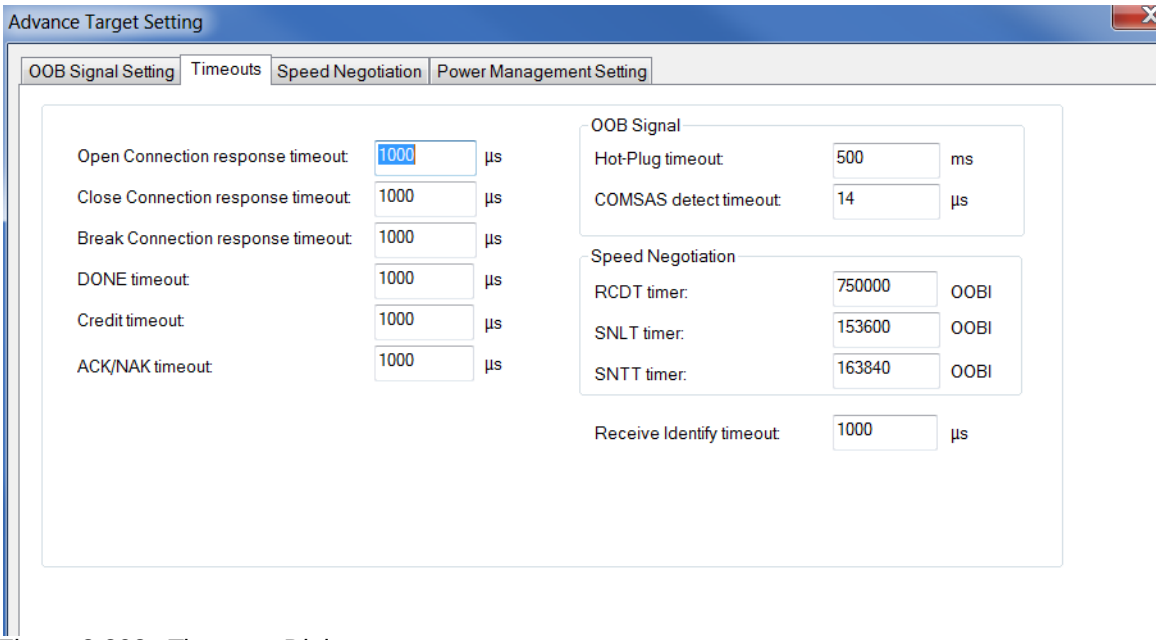


Figure 2.203: Timeouts Dialog

Speed Negotiation

Click the **Speed Negotiation** tab to display the Speed Negotiation dialog. Specify **Speed Negotiating Error Option(s), Speed Negotiating Failure Option(s), Maximum TRAIN_DONE pattern during MTT** and a **Speed Negotiation Failure Type**. Check Pause TRAIN scrambler on primitives

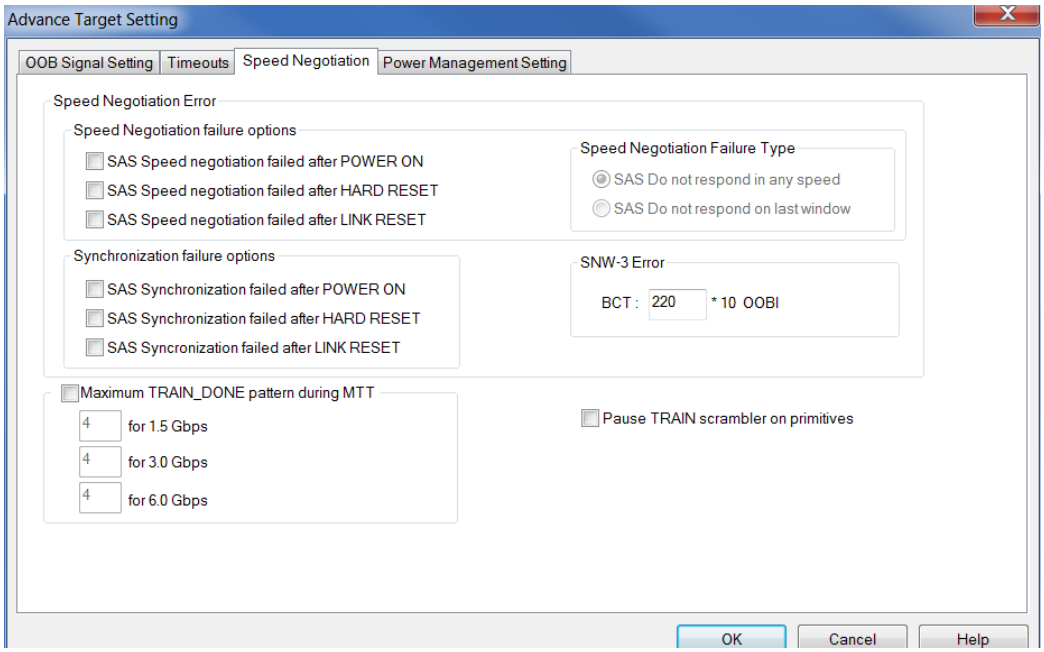

Advance Target Setting
OOB Signal Setting
Timeouts
Speed Negotiation
Power Management Setting
Speed Negotiation Error
Speed Negotiation failure options
SAS Speed negotiation failed after POWER ON
SAS Speed negotiation failed after HARD RESET
SAS Speed negotiation failed after LINK RESET
Speed Negotiation Failure Type
SAS Do not respond in any speed
SAS Do not respond on last window
Synchronization failure options
SAS Synchronization failed after POWER ON
SAS Synchronization failed after HARD RESET
SAS Syncronization failed after LINK RESET
SNW-3 Error
BCT : 220 * 10 OOBI
Maximum TRAIN_DONE pattern during MTT
4 for 1.5 Gbps
4 for 3.0 Gbps
4 for 6.0 Gbps
Pause TRAIN scrambler on primitives
OK
Cancel
Help

Figure 2.204: Speed Negotiation Dialog

Power Management Settings Tab

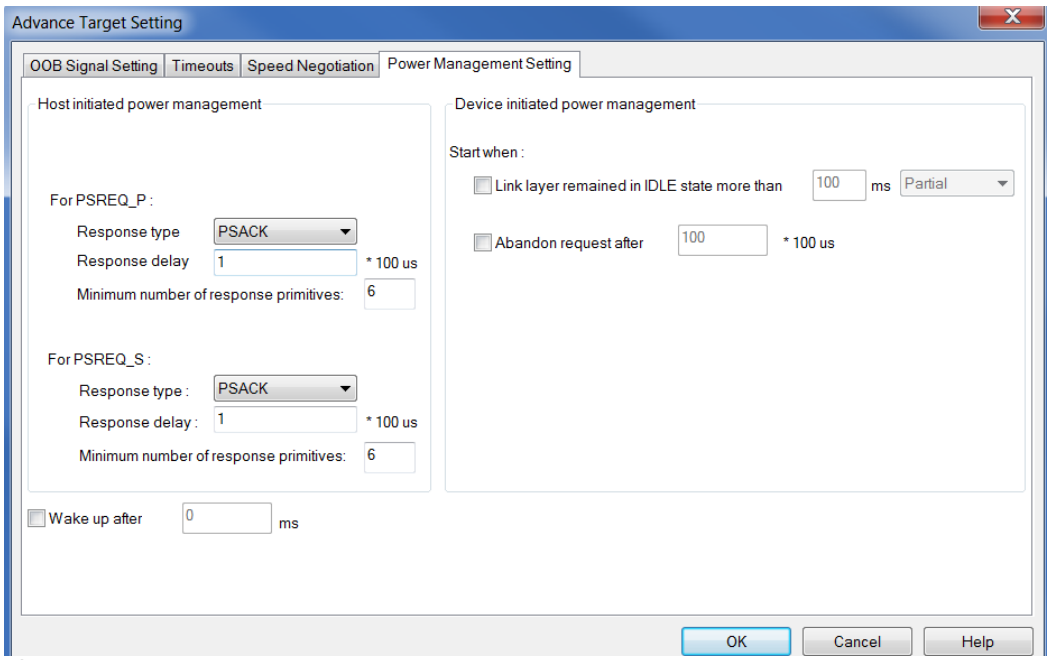

Advance Target Setting
OOB Signal Setting
Timeouts
Speed Negotiation
Power Management Setting
Host initiated power management
For PSREQ_P :
Response type PSACK
Response delay 1 * 100 us
Minimum number of response primitives: 6
For PSREQ_S :
Response type : PSACK
Response delay : 1 * 100 us
Minimum number of response primitives: 6
Wake up after 0 ms
Device initiated power management
Start when :
Link layer remained in IDLE state more than 100 ms Partial
Abandon request after 100 * 100 us
OK
Cancel
Help

Figure 2.205: Power Management

1. In the **Host Initialized Power Management** area, choose whether to support the report in the Identify page.
2. Specify the response type for PMREQ_P and PMREQ_S, the delay, and **Minimum Number of Response Primitives**.
3. In the **Device Initiated Power Management** area choose whether to support the report in the Identify page.
4. Define start event by choosing **Standby timer expires, STANDBY command executes**, or **Link layer remains in IDLE state** more than [XXX] ms.
5. Specify time for **Abandon request** and **Wake up after** and enter the **Standby timer interval**.

NCQ Command Settings Tab

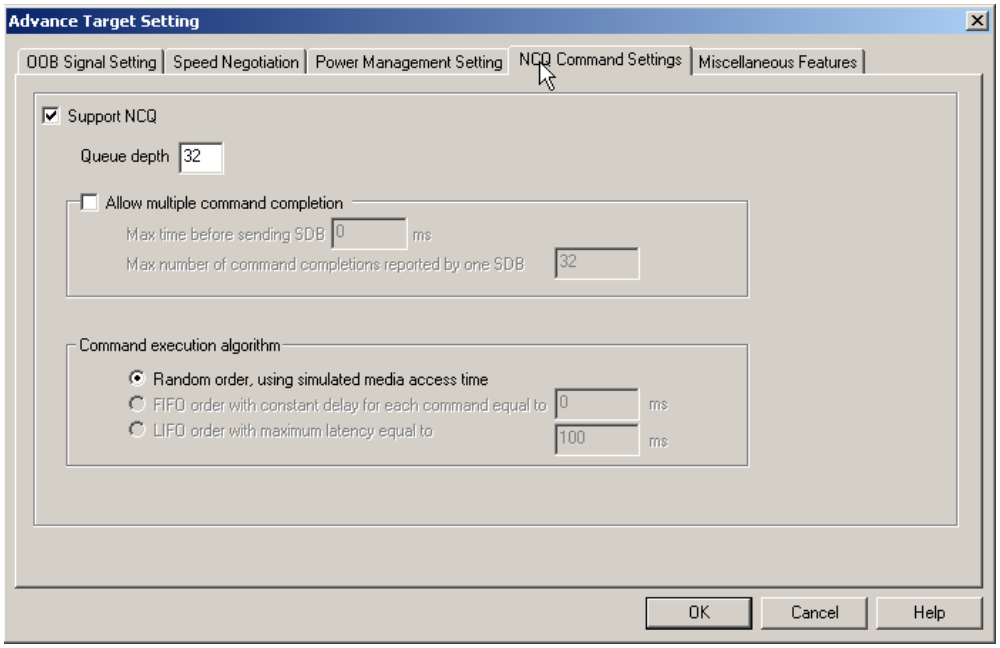


Figure 2.206: NCQ Commands

1. To enable **NCQ** commands, check **Support NCQ** and specify **Queue depth**.
2. Optionally check **Allow multiple command completion** and enter values for **Max time before sending SDP** and **Max number of command completions reported by one SDB**.

Miscellaneous Features Tab

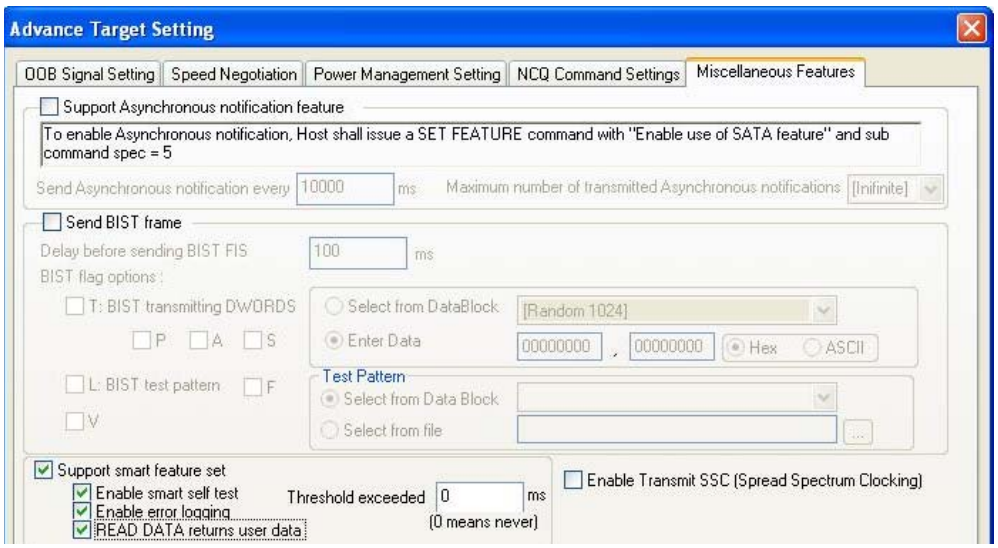


Figure 2.207: Miscellaneous Features

1. To enable Asynchronous notification, check the **Support Asynchronous notification feature,** and then specify the millisecond **Asynchronous notification interval** and the **Maximum number of transmitted Asynchronous notifications**.
2. To send a BIST frame, check **Send BIST frame** and enter a value for the millisecond **Delay before sending BIST FIS**. Choose BIST flag options and enter or select DATA or test pattern.
3. To support smart features, check **Support smart feature set**.
   For self test, check **Enable smart self test**.
   For error logging, check **Enable error logging**.
   To return user data for READ DATA, check **READ DATA returns user data**.
   To set threshold, enter an integer in **Threshold exceeded**. To never exceed threshold, enter **0**.
4. To enable Transmit Spread Spectrum Clocking, check **Enable Transmit SSC**.

2.12.15 Project Note

Click the **Notes** tab and enter a **Project Name** and a brief description of the Device Emulation project (see “Add a Project Note” on page 110).

2.12.16 Using the Power Expansion Card

You can use the Power Expansion Card for Emulation. See “Using the Power Expansion Card” on page 30.

2.12.17 Run Device Emulation

Click the **Activate Device** button to start emulation.

Note: You can run the analyzer while device emulation is active to monitor bus traffic.

Chapter 3

Display Manipulation

3.1 Viewer Display

After data is captured (Recorded), the Viewer displays a sample file (**.scs** for SAS and **.sts** for SATA) in Packet View.

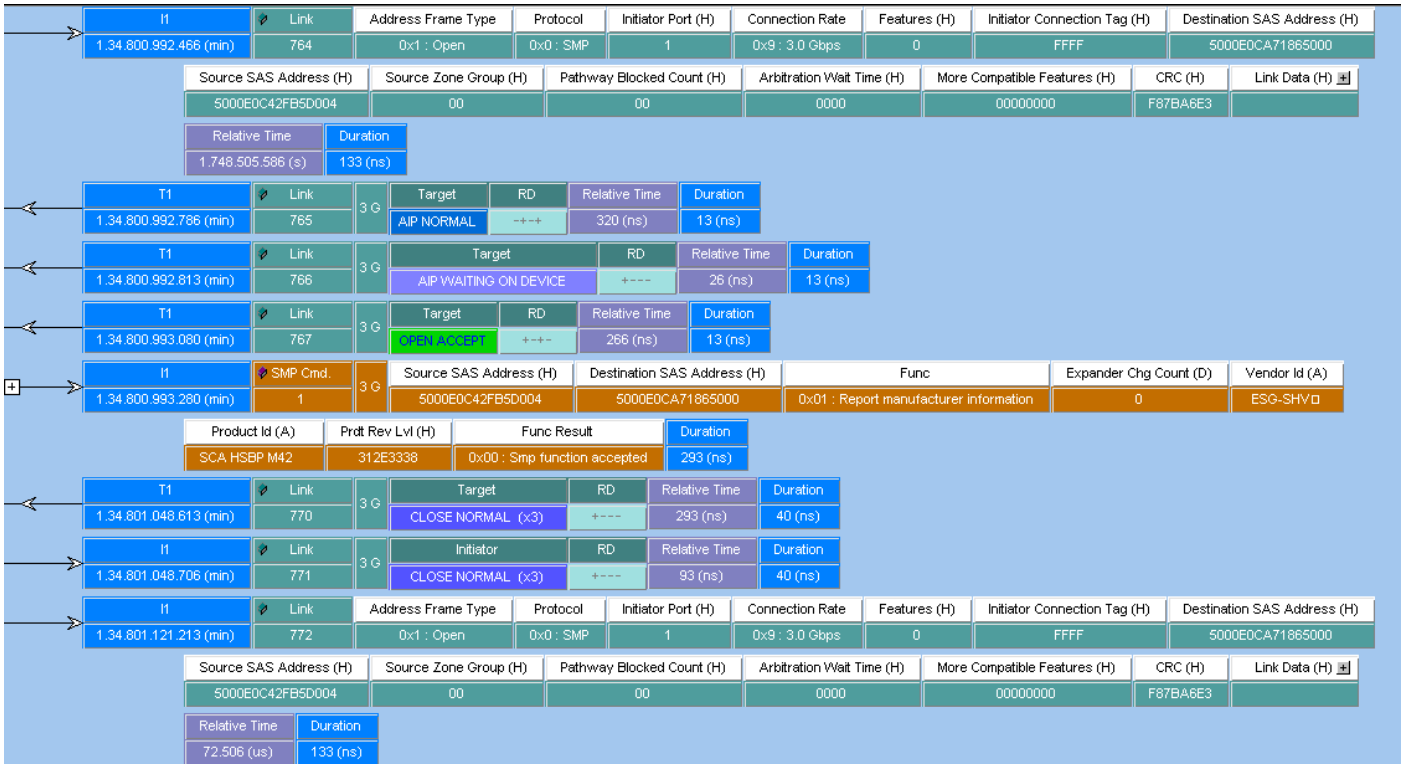


Figure 3.1: SAS: Packet View of .scs Sample File

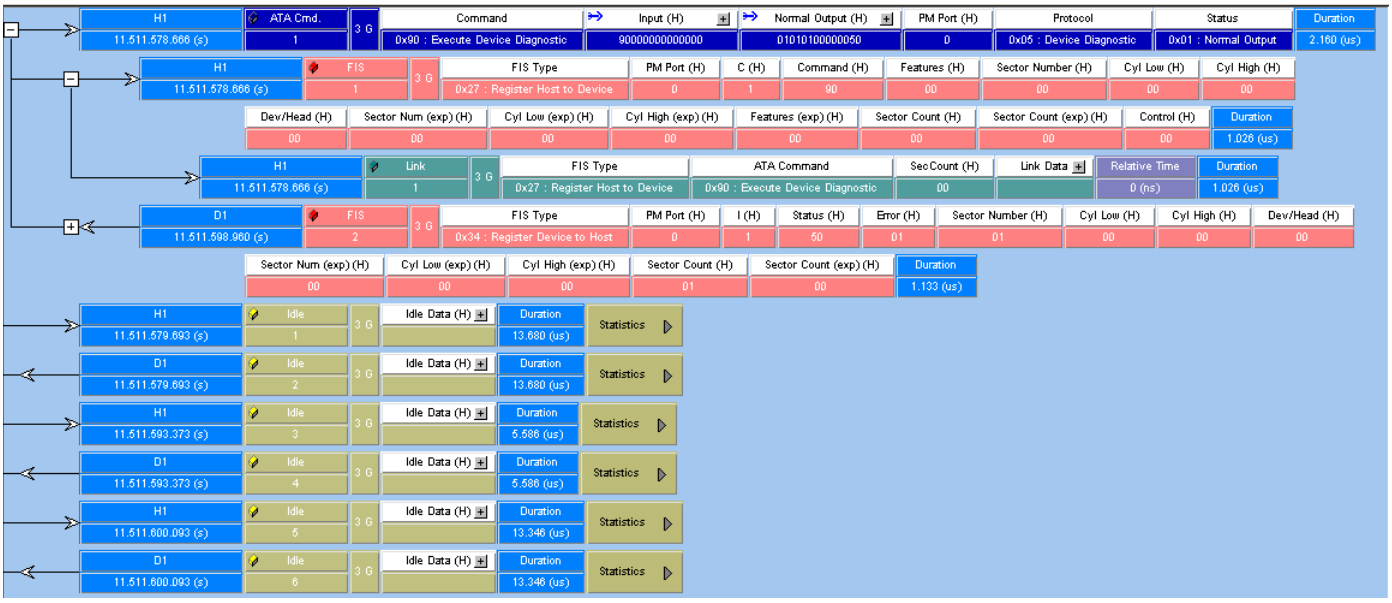


Figure 3.2: SATA: Packet View of .sts Sample File

3.1.1 Quick View

By default, the settings in **Preferences** enable **Quick View**. Quick View allows full access to the whole trace more quickly, especially when using a Gigabit Ethernet connection. However, the trace is NOT written to the host machine's hard drive. To save the trace, you must manually click **Save**.

If you uncheck **Quick View** in the **Preferences** to disable Quick View, the trace loads more slowly, but is automatically saved to the host machine's hard drive. When Quick View is disabled, the Viewer displays successive parts of trace data as they upload. As soon as a trace part uploads, it is available in all trace views.

If you only need quick successive traces, and do not need to save them, keep the default setting to enable Quick View.

If you need to save all captured traces, unchecking the Quick View setting loads traces faster, especially for larger traces and slower connections than Gigabit Ethernet.

To refresh the viewer display with more uploaded data, scroll to the end of the trace, using scroll bars, page down, arrow down, or CTRL-End. Newly uploaded data then appears there.

Note: High-level decoding and statistics are available only after the whole trace has uploaded.

The software automatically switches to full trace view after trace uploading finishes.

Note: Users must press **CTRL Home** to go to the beginning of an uploaded trace, and **CTRL End** to go to the end of an uploaded trace.

3.1.2 Using the Viewer Display

To configure the data viewer display, use the toolbars. You can display the same data in:

- Packet view
- Spreadsheet view
- Column view, with transactions grouped for each active port
- Text view, with transactions grouped for each active port
- Waveform view
- Frame Inspector view
- Histogram view
- Bus Utilization view
- Data Report
- Statistical Report view

To change the view type when opening a trace, change the default workspace or save options in the **Preferences** dialog.

To toggle among open windows, use **CTRL - TAB**.
To reverse toggle order, use **CTRL - SHIFT - TAB**.

To make a frame a trigger pattern, in Packet View, right-click any frame, select **Add to Trigger**, and add the pattern to **DataPatternCapture**.

Viewer Display enables you to also perform the following:

- Decode Assignments (Refer to “Decoding Assignments” on page 210 for more details.)
- Compare Two Data Payloads (Refer to “Compare Two Data Payloads” on page 246 for more details.)
- Run Verification Scripts (Refer to “Running Verification Script Engine (VSE)” on page 252 for more details.)

3.2 Trace Properties

The Trace Properties dialog displays (see Figure 3.3 on page 208):

- Software version
- Sample file version
- Grouping Type
- Hardware bin file version
- Analyzer armed at
- Analyzer triggered at
- Sample saved at
- Original Capture Project: **Open** displays the project settings used to capture the sample.
- Licensing Information

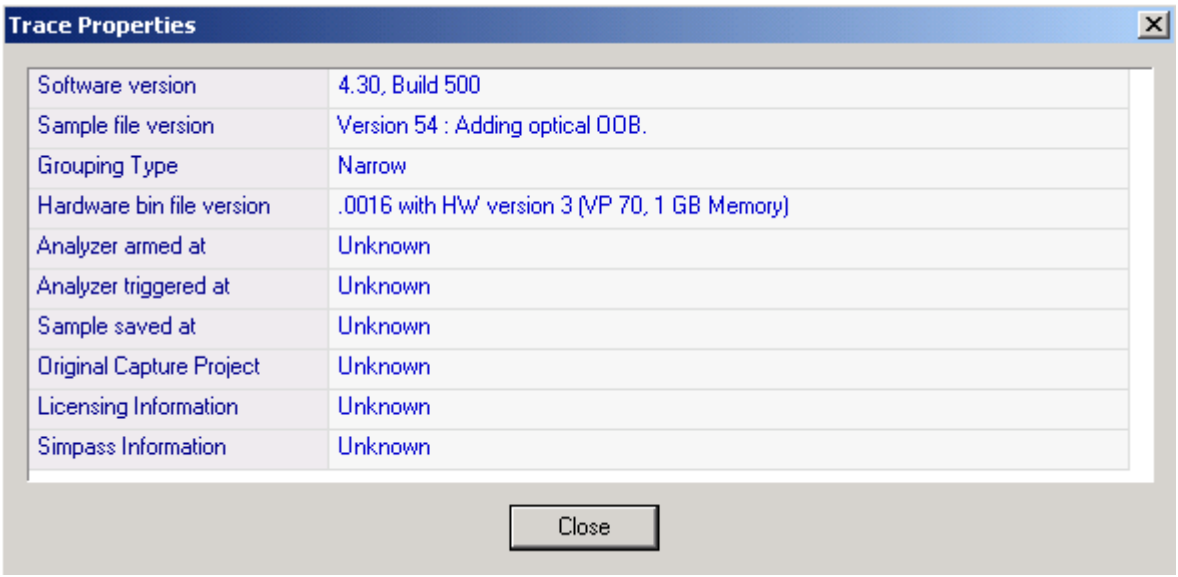


Figure 3.3: Trace Properties Dialog

3.3 Analysis

The Analysis menu options allows you to see the trace in various views and switch views.

3.3.1 Show Analysis Toolbar

To display the capture in any of the other available views you can make the selection on the View Type toolbar as shown below or select the menu option under Analysis as shown in Figure 3.5 on page 209.

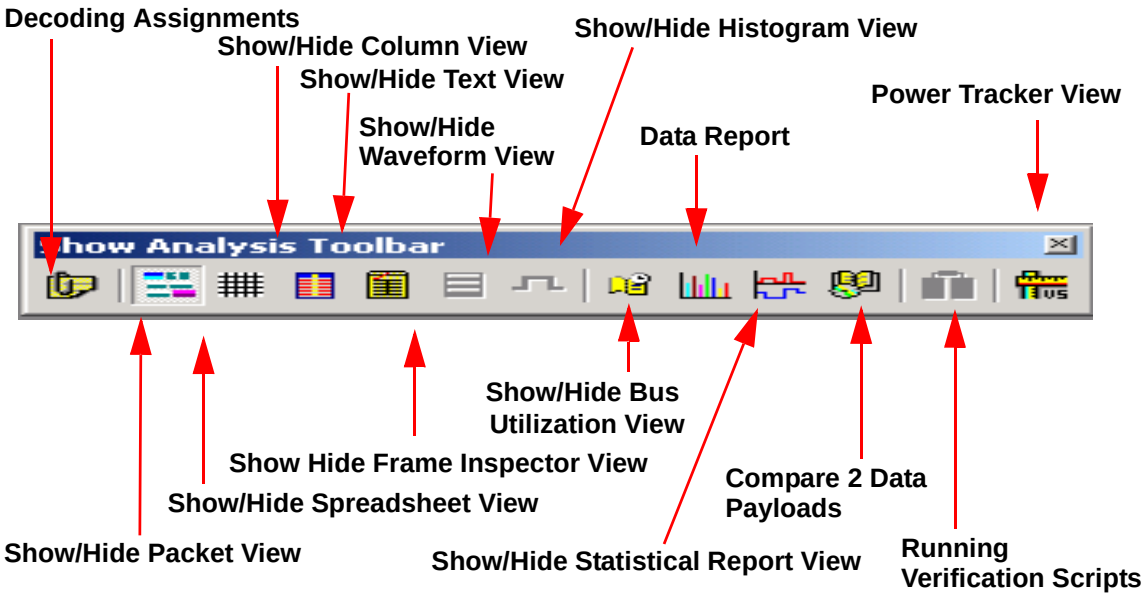


Figure 3.4: View Type Toolbar

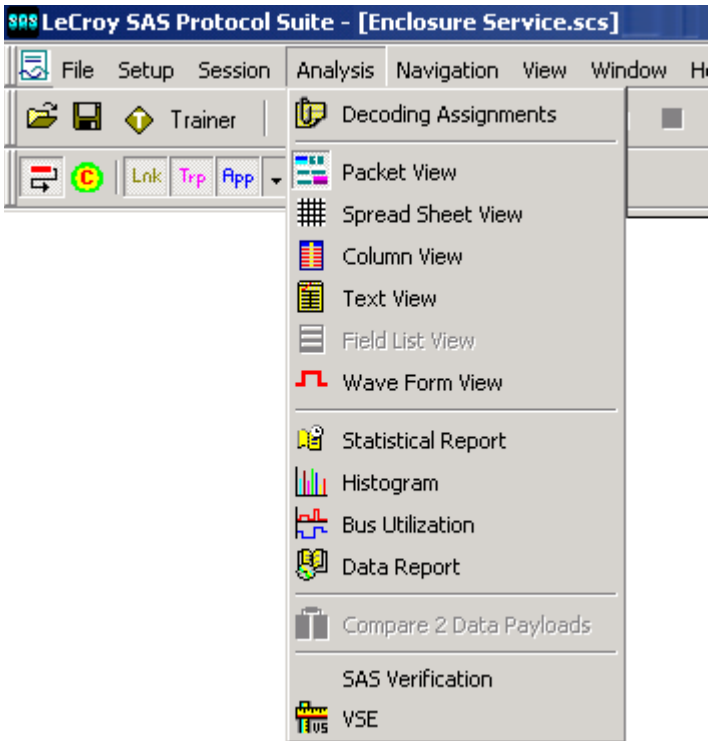


Figure 3.5: SAS Analysis Menu

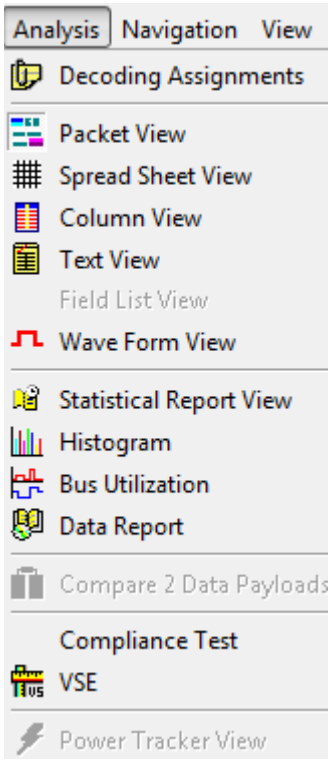


Figure 3.6: SATA Analysis Menu

3.3.2 Decoding Assignments

Click on the Decoding Assignments icon to display the Decoding Assignment dialog. Check a **Hash Destination SAS Address** checkbox to select it and select a **SCSI Spec(s)**. Click the **Add to Assigned List** button to decode. Select a spec and click **Remove it** or click on **Remove All** to remove all the specs.

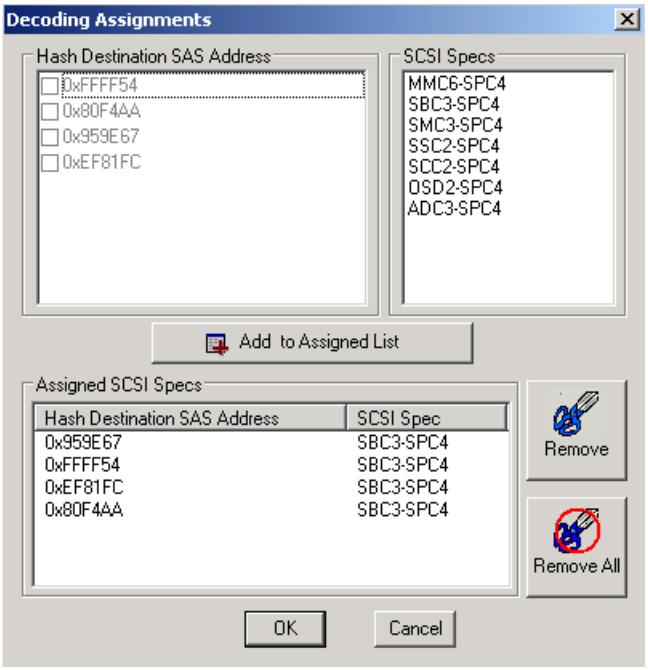


Figure 3.7: Decoding Assignments Dialog for SAS

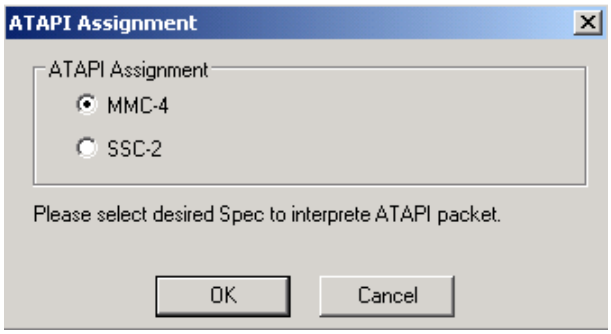


Figure 3.8: ATAPI Assignment Dialog for SATA

3.3.3 Packet View

After you select a view, it appears in a separate window. To increase the new window display size, select **Analysis > Packet View** or, click the **Show/Hide Packet View** button.

When scrolling through either display using the scroll bar, the corresponding display in the other view scrolls with it.

You can rearrange the tiling by clicking **Window** and choosing **Cascade, Tile Vertical,** or **Tile Horizontal**.

Packet View Metrics

The Metrics feature provides quick access to additional information about the packet data. Click the Metrics + icon as shown in Figure 3.9 to display the details.

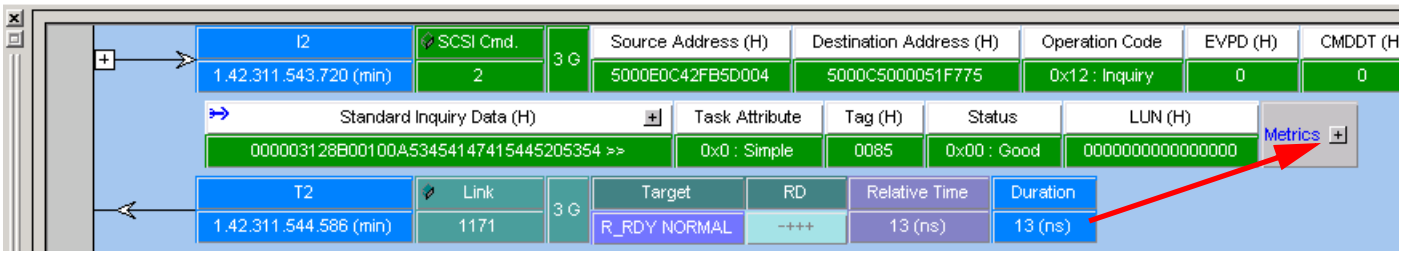


Figure 3.9: Packet View Metrics

The following additional information of the packet is displayed when the Metrics field is expanded. Refer to Figure 3.10 on page 212.

Trp. No. - Number of Transports

The total number of transports that compose this exchange.

Resp. Time - Response Time

The time taken to transmit this command on the link(s) from the beginning of the first frame in the command to the end of the last frame in the command.

Pld. Bytes - Payload Bytes

The number of payload bytes this operation transferred.

Latency Time

The time measured from the transmission of the command to the first data transmitted for this IO operation.

Data-Stat. Time - Data to Status Time

The time between the end of data transmission for this command and the Status frame.

Thrpt MB/s- Data Throughput

The payload divided by response time expressed in MB per second.

Duration

The time taken from the first DWord to the last DWord in a line.

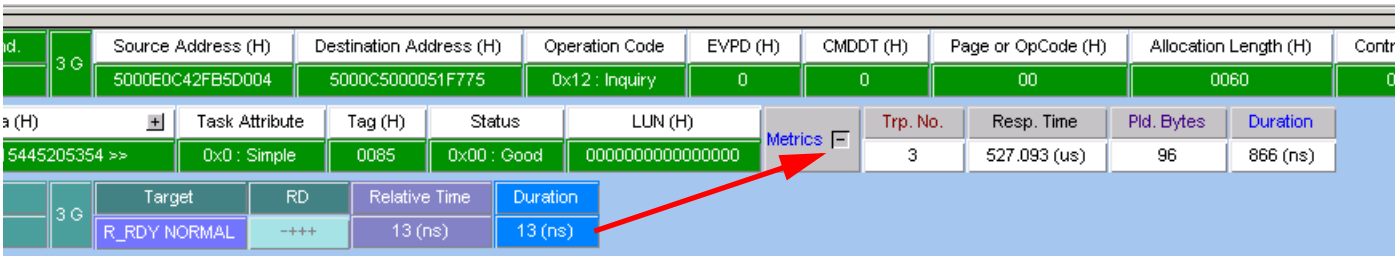


Figure 3.10: Packet View Metrics Expanded

Copying Packets from a Trace to a Host Emulator Script

This check mark in the illustration below shows packet (s) selected to copy. You can copy packet(s) from a trace and paste it into a host emulator script. That is why you can only mark packets that we support in emulator and host side packets. You can also mark multiple packets by left-clicking and moving the mouse over multiple packets and then right-click to select them, and paste them in an emulator script.

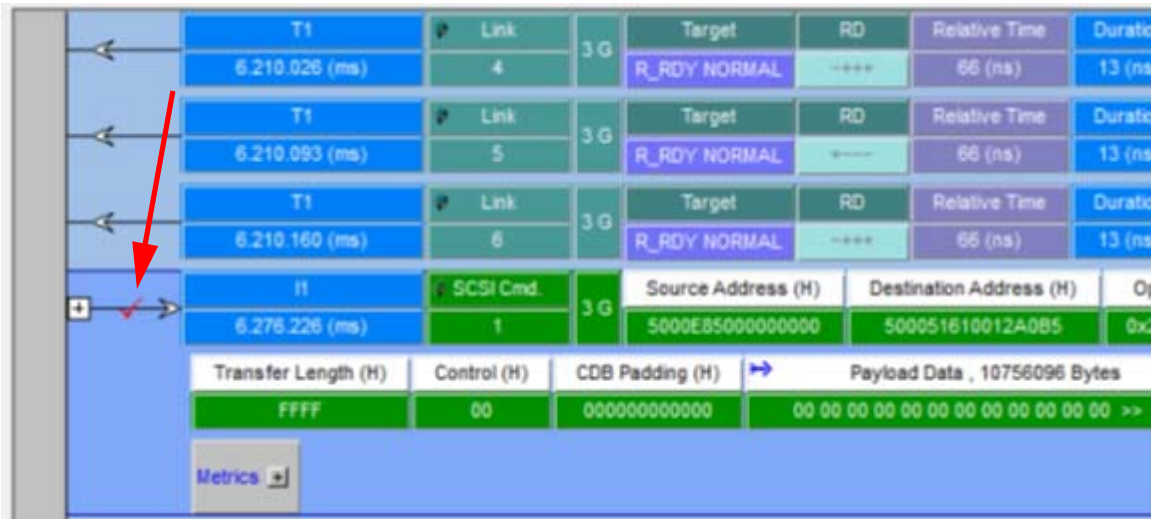


Figure 3.11: Packets Selected to Copy

Device Sleep (DevSlp)

The Device Sleep status is displayed throughout the trace by right-clicking and selecting **Device Sleep** in Packet View.

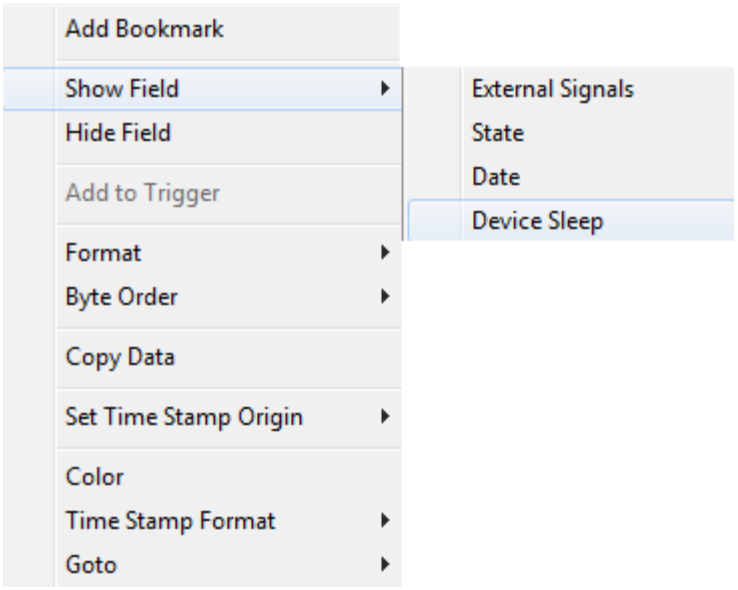


Figure 3.12: Right-click Device Sleep Menu

The trace now displays the Device Sleep fields of all the packets (see Figure 3.13 on page 213).

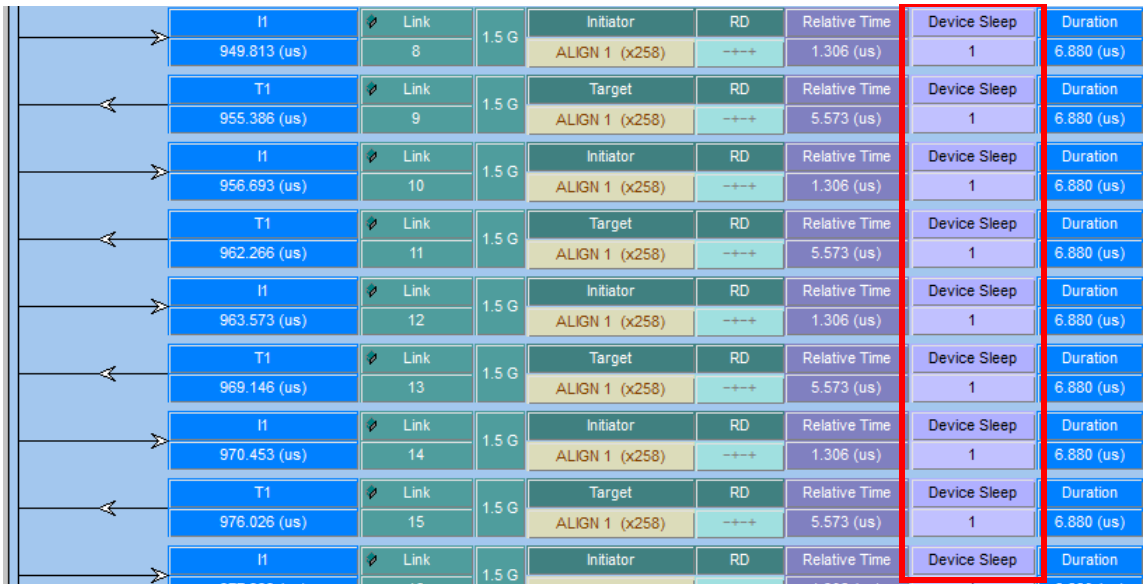

I1 949.813 (us) | Link 8 | 1.5 G | Initiator ALIGN 1 (x258) | RD -+-+ | Relative Time 1.306 (us) | Device Sleep 1 | Duration 6.880 (us)
T1 955.386 (us) | Link 9 | 1.5 G | Target ALIGN 1 (x258) | RD -+-+ | Relative Time 5.573 (us) | Device Sleep 1 | Duration 6.880 (us)
I1 956.693 (us) | Link 10 | 1.5 G | Initiator ALIGN 1 (x258) | RD -+-+ | Relative Time 1.306 (us) | Device Sleep 1 | Duration 6.880 (us)
T1 962.266 (us) | Link 11 | 1.5 G | Target ALIGN 1 (x258) | RD -+-+ | Relative Time 5.573 (us) | Device Sleep 1 | Duration 6.880 (us)
I1 963.573 (us) | Link 12 | 1.5 G | Initiator ALIGN 1 (x258) | RD -+-+ | Relative Time 1.306 (us) | Device Sleep 1 | Duration 6.880 (us)
T1 969.146 (us) | Link 13 | 1.5 G | Target ALIGN 1 (x258) | RD -+-+ | Relative Time 5.573 (us) | Device Sleep 1 | Duration 6.880 (us)
I1 970.453 (us) | Link 14 | 1.5 G | Initiator ALIGN 1 (x258) | RD -+-+ | Relative Time 1.306 (us) | Device Sleep 1 | Duration 6.880 (us)
T1 976.026 (us) | Link 15 | 1.5 G | Target ALIGN 1 (x258) | RD -+-+ | Relative Time 5.573 (us) | Device Sleep 1 | Duration 6.880 (us)
I1 | Link | 1.5 G | Initiator | RD | Relative Time | Device Sleep | Duration

Figure 3.13: Device Sleep Fields

3.3.4 Changing the Default View

Perform the following steps to change the default view of all trace files to Packet View:

1. Open a trace file.

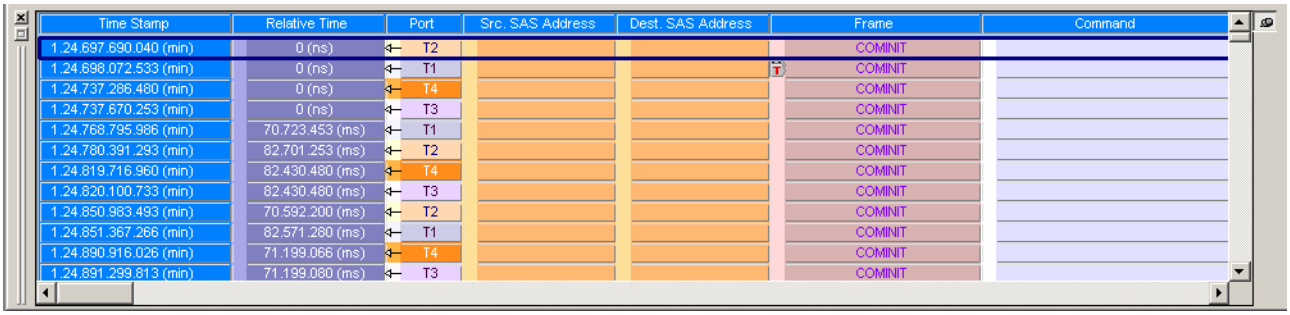
2. Select the **Packet View**. Close all other views.
3. Select **File > Save Workspace** to open a Save As dialog. Save the current workspace as a **.wss** file.
4. Select **Setup > Preferences** and select the Trace Viewer tab.
5. In the Default Workspace field, enter the path and name of the workspace **.wss** file that you saved in step 3.

Because the default workspace contains only Packet View, the software opens trace files in Packet View.

3.3.5 Spreadsheet View

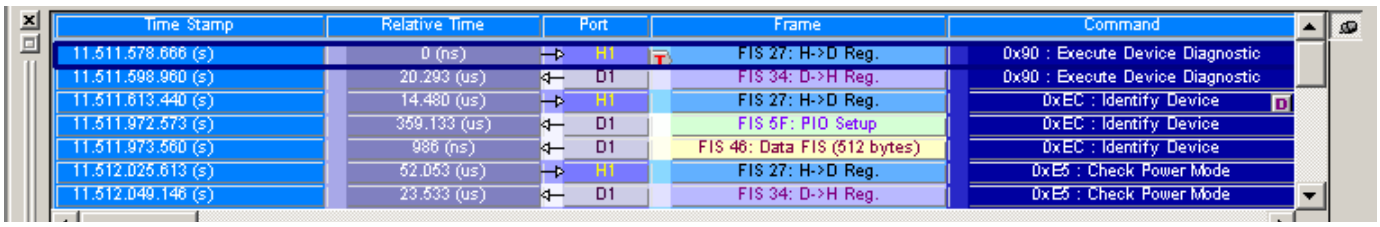
Spreadsheet View displays all of the Packet View fields in a time sequential spreadsheet format. To display the Spreadsheet View of the current capture, click

Analysis > Spreadsheet View or click the button on the toolbar.



Time Stamp	Relative Time	Port	Src. SAS Address	Dest. SAS Address	Frame	Command
1.24.697.690.040 (min)	0 (ns)	T2			COMINIT	
1.24.698.072.533 (min)	0 (ns)	T1			COMINIT	
1.24.737.286.480 (min)	0 (ns)	T4			COMINIT	
1.24.737.670.253 (min)	0 (ns)	T3			COMINIT	
1.24.768.795.986 (min)	70.723.453 (ms)	T1			COMINIT	
1.24.780.391.293 (min)	82.701.253 (ms)	T2			COMINIT	
1.24.819.716.960 (min)	82.430.480 (ms)	T4			COMINIT	
1.24.820.100.733 (min)	82.430.480 (ms)	T3			COMINIT	
1.24.850.963.493 (min)	70.592.200 (ms)	T2			COMINIT	
1.24.851.367.266 (min)	82.571.280 (ms)	T1			COMINIT	
1.24.890.916.026 (min)	71.199.066 (ms)	T4			COMINIT	
1.24.891.299.813 (min)	71.199.080 (ms)	T3			COMINIT	

Figure 3.14: SAS: Spreadsheet View



Time Stamp	Relative Time	Port	Frame	Command
11.511.578.666 (s)	0 (ns)	H1	FIS 27: H->D Reg.	0x90 : Execute Device Diagnostic
11.511.598.960 (s)	20.293 (us)	D1	FIS 34: D->H Reg.	0x90 : Execute Device Diagnostic
11.511.613.440 (s)	14.480 (us)	H1	FIS 27: H->D Reg.	0xEC : Identify Device
11.511.972.573 (s)	359.133 (us)	D1	FIS 5F: PIO Setup	0xEC : Identify Device
11.511.973.560 (s)	986 (ns)	D1	FIS 46: Data FIS (512 bytes)	0xEC : Identify Device
11.512.025.613 (s)	52.053 (us)	H1	FIS 27: H->D Reg.	0xE5 : Check Power Mode
11.512.049.146 (s)	23.533 (us)	D1	FIS 34: D->H Reg.	0xE5 : Check Power Mode

Figure 3.15: SATA: Spreadsheet View

Right-click a column heading to go to **Software Settings**, make all columns the same width, choose **Time Stamp Format**, or **Goto** a position.

Right-click a column heading to **Hide** or **Show** the column. To show the same columns permanently, select **Setup > Preferences > Trace Viewer > As Previously Saved**.

Right-click the column to **Add Bookmark** or **Edit Bookmark**, **Set Time Stamp Origin**, go to **Software Settings**, choose **Time Stamp Format**, **Change Background (or Foreground) Color**, or **Goto** a position.

Note: You can double-click a data frame to display the data payload view.
The Status column can show ABRT and UNC status.

Save As Text/Excel

Select **File > Save As Text/Excel** to open the Save As Text dialog.

For Save As Type, select **Text Files** or **Excel Files**.

For Save As Range, select **All Packets** or enter a cursor range.

Enter a **File Name** and click **Save**.

Note: The Save As Excel option is available only for Column View and Spreadsheet View.

Change Format of Logical Block Address (LBA)

You can set different LBA formats in Packet View and Spreadsheet View. To change the LBA format, right-click the LBA column to display the popup menu, select **Format,** and change the format to **Decimal, Hexadecimal,** or **Binary**.

In Spreadsheet View, you can also click the **Trace Viewer Configuration** icon to display the Trace Viewer Configuration dialog. Expand the **Frame List/Spread Sheet View**, select **LBA/Sector#**, and change the **Format**. If you cannot change the format there, select the **Link Fields, Transport Fields, ATA Cmd. Fields**, or **SCSI Cmd. Fields** node, select the field (such as “LBA High”), and then change the **Format**.

3.3.6 Column View

Column View displays the captured data grouped in columns by port. Each row shows captured DWORDs on different ports related to the timestamp. It also shows different speed (1.5G, 3G, 6G) DWORDs. Different DWORD cell height shows the duration of the DWORD. To display Column View of the current capture, click **Analysis > Column View** or click the button on the View Type toolbar.

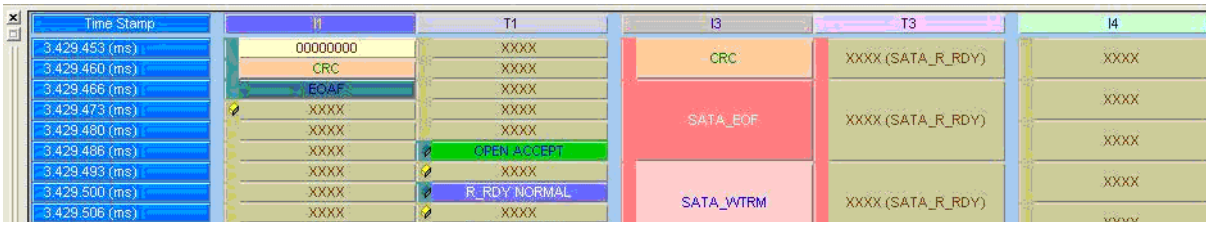


Figure 3.16: SAS: Column View

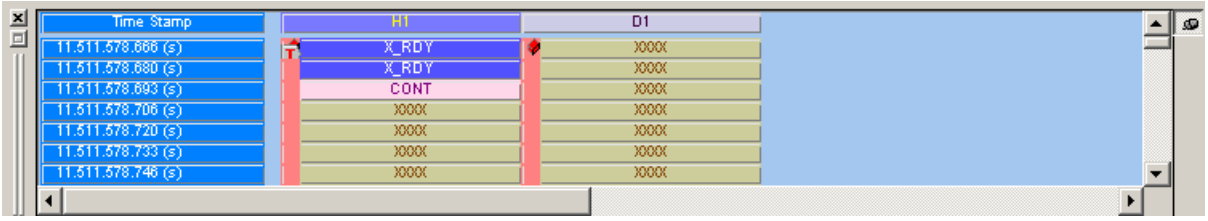


Figure 3.17: SATA: Column View

Right-click in the Column View to display commands:

- Software Settings
- Time Stamp Format (LeCroy Format, Milli Second, Micro Second)
- Go to (Trigger Position, X Position, Y Position, Packet Number, Time Stamp, Bookmark, Begin, End)
- Bookmark
- Goto within Packet (SOF, EOF, Next HOLD, Previous HOLD, Next HOLDA, Previous HOLDA, Next Align, Previous Align, Next R_IP, Previous R_IP)

Note: The Column View displays the CRC value. To see different formats (10b, 8b, scrambled, and so on), select a format by clicking its Tool menu button.

Resize Columns

You can resize the columns in Column View by clicking in the column boundary and dragging the boundary to a new position.

Rearrange Columns

You can rearrange columns by left-clicking in the column title and then dragging the drag-and-drop icon to a new position.

Save As Text/Excel

Select **File > Save As Text/Excel** to open the Save As Text dialog.

For Save As Type, select **Text Files** or **Excel Files**.

For Save As Range, select **All Packets** or enter a cursor range.

Enter a **File Name** and click **Save**.

Note: The Save As Excel option is available only for Column View and Spreadsheet View.

3.3.7 Text View

Text View (see Figure 3.18 on page 217)displays the captured data interpreted as transaction frames, grouped in columns by port. To display Text View, select **Analysis > Text View** or click the button on the View Type toolbar.

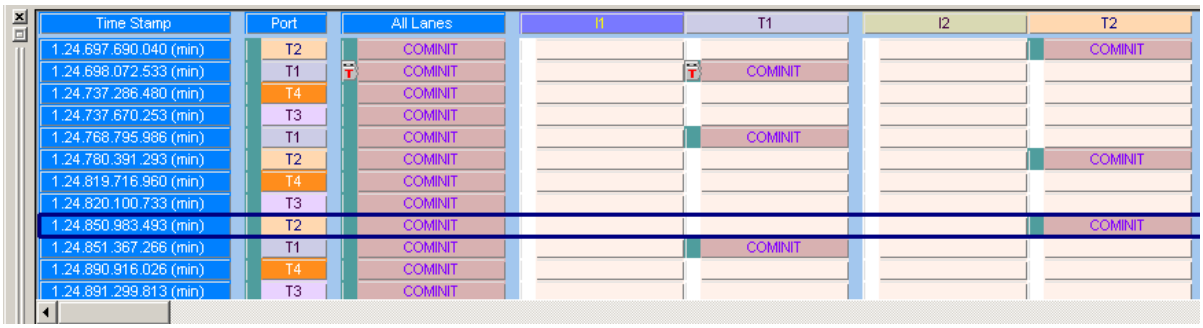


Figure 3.18: SAS: Text View

.

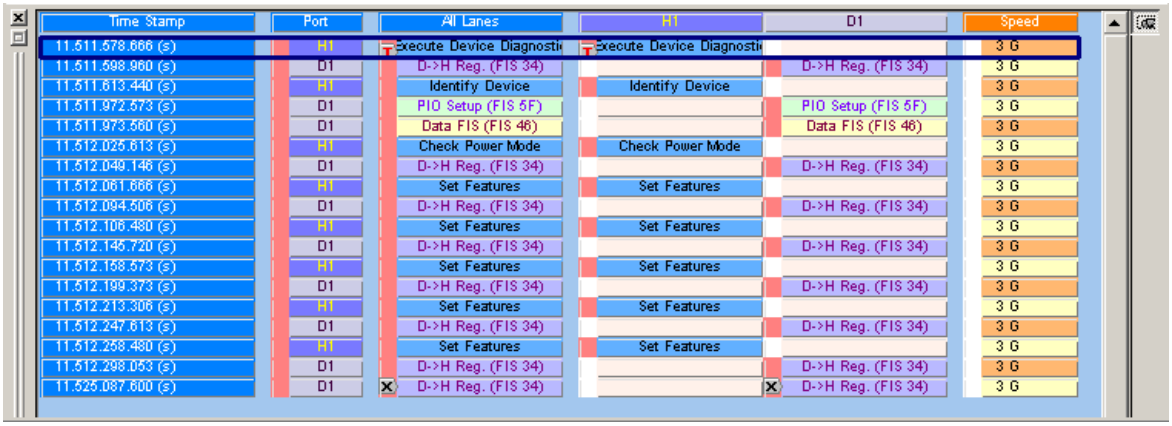

Time Stamp
Port
All Lanes
H1
D1
Speed
11.511.578.666 (s) H1 Execute Device Diagnosti Execute Device Diagnosti 3 G
11.511.598.960 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.511.613.440 (s) H1 Identify Device Identify Device 3 G
11.511.972.573 (s) D1 PIO Setup (FIS 5F) PIO Setup (FIS 5F) 3 G
11.511.973.560 (s) D1 Data FIS (FIS 46) Data FIS (FIS 46) 3 G
11.512.025.613 (s) H1 Check Power Mode Check Power Mode 3 G
11.512.049.146 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.512.061.666 (s) H1 Set Features Set Features 3 G
11.512.094.506 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.512.106.480 (s) H1 Set Features Set Features 3 G
11.512.146.720 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.512.158.573 (s) H1 Set Features Set Features 3 G
11.512.199.373 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.512.213.306 (s) H1 Set Features Set Features 3 G
11.512.247.613 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.512.258.480 (s) H1 Set Features Set Features 3 G
11.512.298.053 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G
11.525.087.600 (s) D1 D->H Reg. (FIS 34) D->H Reg. (FIS 34) 3 G

Figure 3.19: SATA: Text View

Note: The LBA and Tag Number value are shown in the All Lanes column.

3.3.8 Frame Inspector View

Frame Inspector View has lots of information that is available in Packet View, but not Spreadsheet View, so it is most useful in conjunction with the Spreadsheet View. This view has the following three tabs:

Spec View:

This view shows the Frame as it would appear in the spec, with the field names and values spelled out clearly. Fields that are too short to clearly contain the description can be viewed as tooltips by hovering the mouse over them. Some fields might have a a lowercase ‘e’ button at the top right corner. Pressing this button displays an ‘expanded’ view of the sub-fields in this field.

Field View:

This view shows, when applicable, a hierarchical display of the selected Packet, with the relevant fields in each level.

To open a Frame Inspector View of the current capture, select **View > Frame Inspector View** or click the button on the View Type.

toolbar.

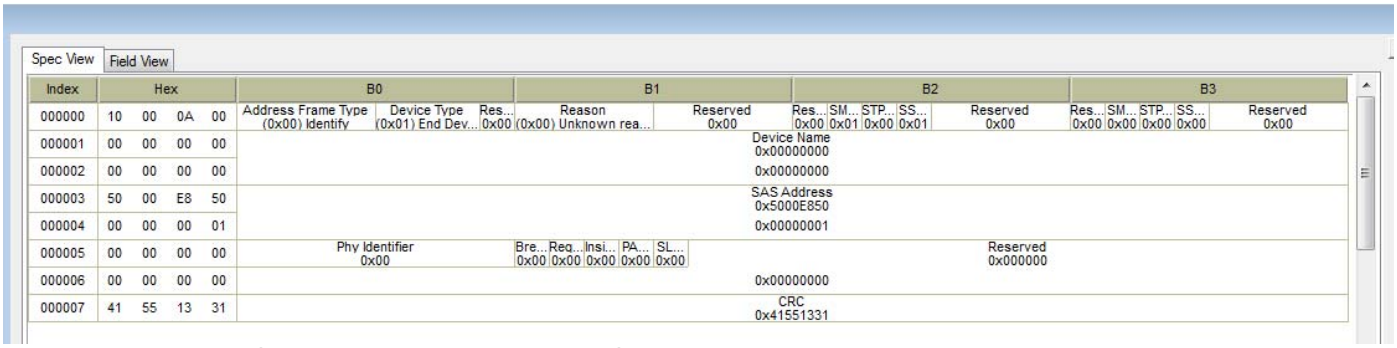


Figure 3.20: Frame Inspector View

3.3.9 Waveform Display

You can enable a waveform display for all active ports, and perform timing measurements, by positioning timing cursors within the waveform display (see Figure 3.21 on page 218).

Select **View > Wave Form View** or click the **Show/Hide Waveform** button on the View Type toolbar to enable the waveform display.

The Compact View shows the OOB Sequence with speed negotiation.

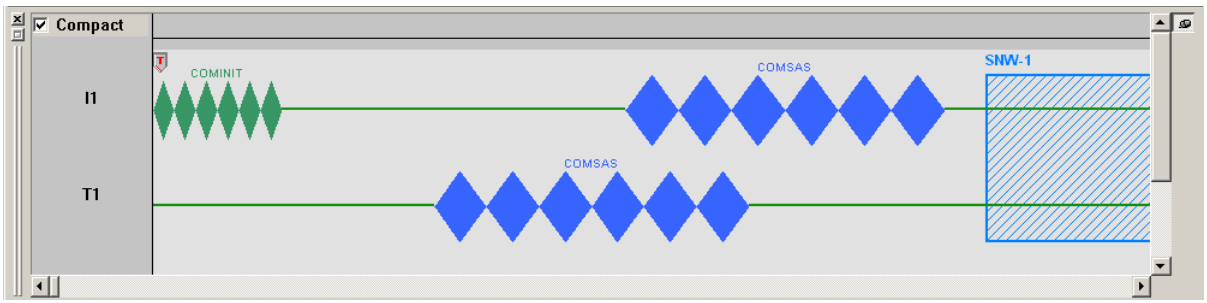


Figure 3.21: SAS: Waveform View

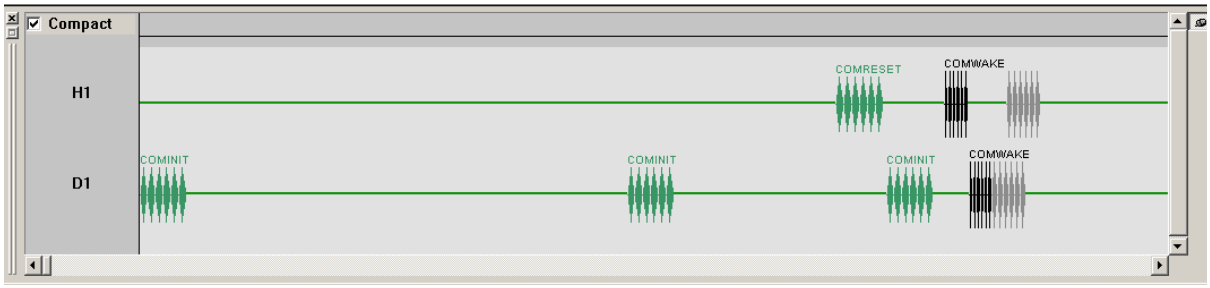


Figure 3.22: SATA: Waveform View

Making a Timing Measurement

Timing measurements are made with two timing cursors T1 and T2. Click the left mouse button in the gray bar on the top of the waveform display at a point for the T1 cursor, and the right mouse button at a point for the T2 cursor. The time difference between the cursors is on a line connecting the two cursors.

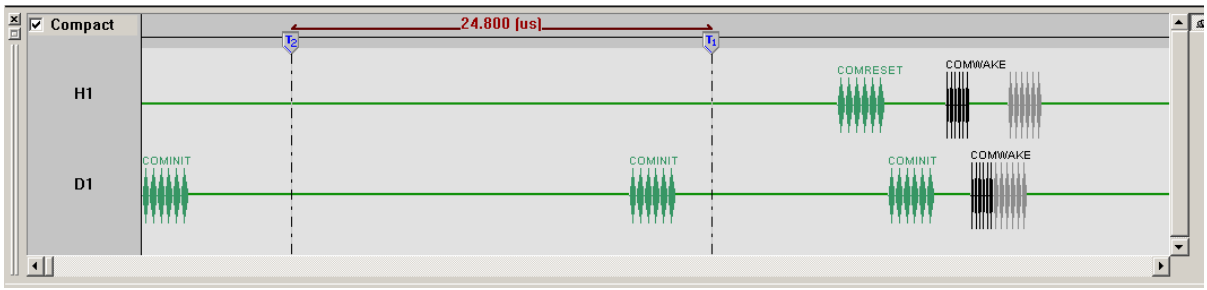


Figure 3.23: SATA: Timing Cursors Enabled

Expanded Waveform View

To see a 10x time scale expansion of the waveform, uncheck the **Compact View** checkbox in the Waveform View window. The OOB Sequence has speed negotiation (Hardware version 4 or later).

.

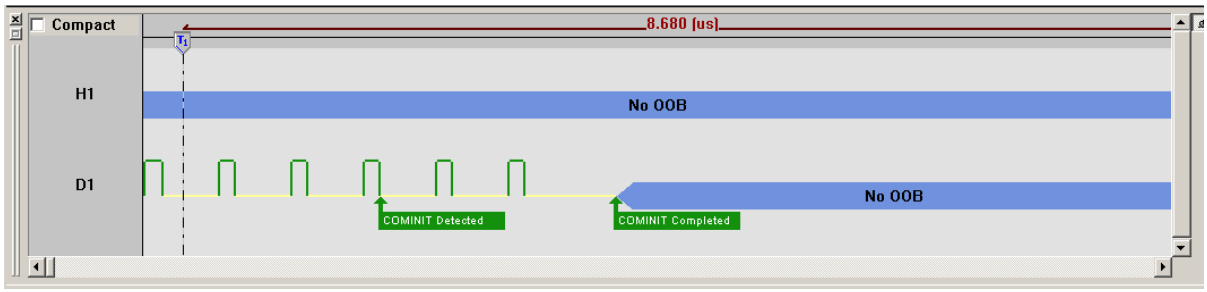


Figure 3.24: SATA: Expanded Waveform View

3.3.10 Statistical Report

Whenever a captured sample is in the Sample Viewer, a **Statistical Report** selection in the **Report** menu and a **Statistical Report Button** on the viewer toolbar are enabled. You can create a Statistical Report for the entire capture or select a portion of it.

To display a Statistical Report, click the **Statistical Report** button on the viewer toolbar or select **Analysis > Statistical Report** to display the **Select Statistical Report Range** dialog.

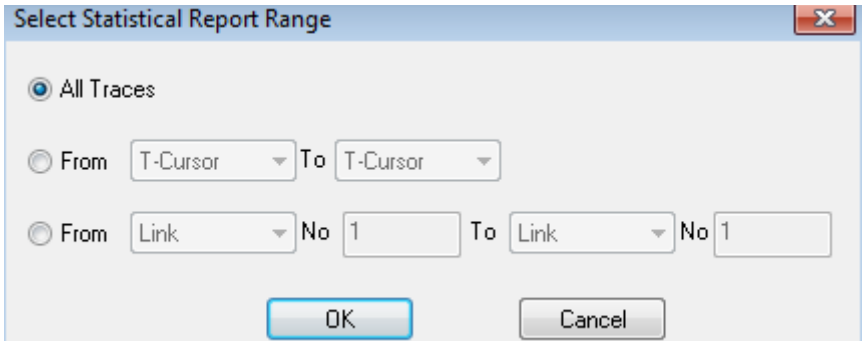


Figure 3.25: Statistical Report Range Dialog

The default statistical report has All Samples. You can set a specific Statistical report range between defined cursor positions or events.

Generating Statistical Read/Write Report

To create a statistical read/write page perform the following steps:

1. Click on the **Setup > Preferences** menu option.
2. Click on the **Trace Viewer** tab.
3. Check the box **Create statistical report read/write page** (see Figure 3.25 on page 220).

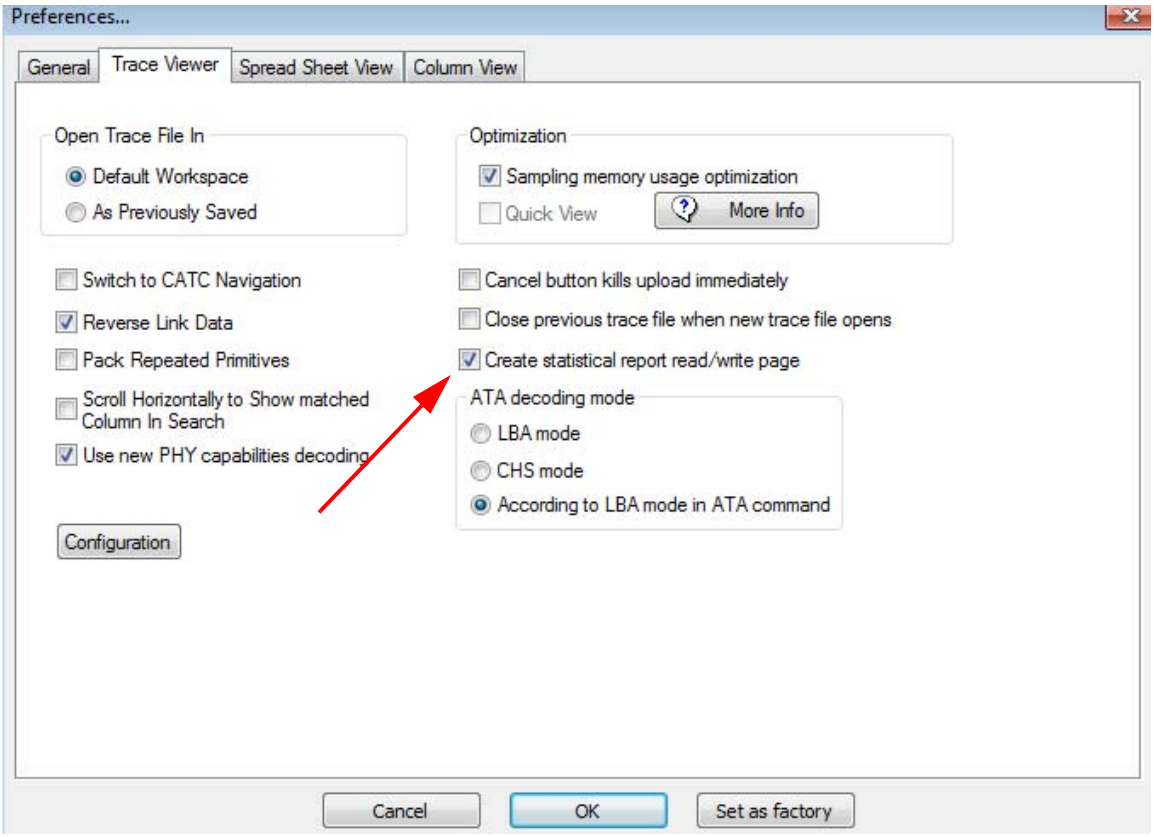


Figure 3.26: Enabling Read/Write Statistical Report

Note: This settings should be enabled before you capture the trace file.

If you have already captured a trace file and want to create a read/write statistical report for the sample, perform the following steps:

1. Enable the read/write settings as mentioned above.
2. Open the trace file.
3. Set the X pointer on the first packet in the viewer.
4. Set the Y pointer on last packet in the viewer.
5. Save as the trace file using the X to Y option.

   Now the saved trace file will contain the read/write statistical report.

Report between Cursors

Click the option button next to the **From** cursor selection drop down list. Then click the **From** down arrow and choose the 1st cursor, click the **To** down arrow to choose the 2nd cursor, and click **OK.** The resulting report has only the capture between the cursors.

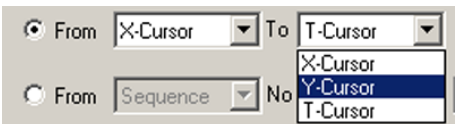


Figure 3.27: Report between Cursors

Report between Events

Click the option button next to the **From** the event selection dropdown list, click the **From** down arrow to choose the 1st event, then enter the number of its occurrence. Next click the **To** down arrow to choose the 2nd event, then enter the number of its occurrence.

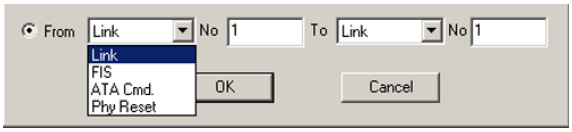


Figure 3.28: SATA: Report between Events

Click **OK.** The resulting report are limited to the capture between the defined events.

SAS vs. SATA: SAS adds Transport, SCSI Cmd, SMP Cmd, and Task Mng to the drop-down list and deletes FIS and Phy Reset.

Statistical Report Content

SAS: A complete SAS statistical report consists of the following reports, accessed by clicking the corresponding tab in the dialog:

- General
- Bus Condition
- Primitive
- SSP Transport
- SMP Transport
- STP Transport
- ATA Command
- SCSI Command
- SMP Command
- Task Command
- SAS Address
- Read/Write Command
- Protocol Error
- Performance
- Lanes
- Others

SATA: A complete SATA statistical report consists of the following reports, accessed by clicking the corresponding tab in the dialog:

- General
- Bus Condition
- Primitive
- FIS
- ATA Command
- ATAPI Command
- Read/Write Command

- Protocol Error
- Performance
- Others
- PM Statistic
- PM Performance

Note: Results are displayed only for items that have been captured in the sample.

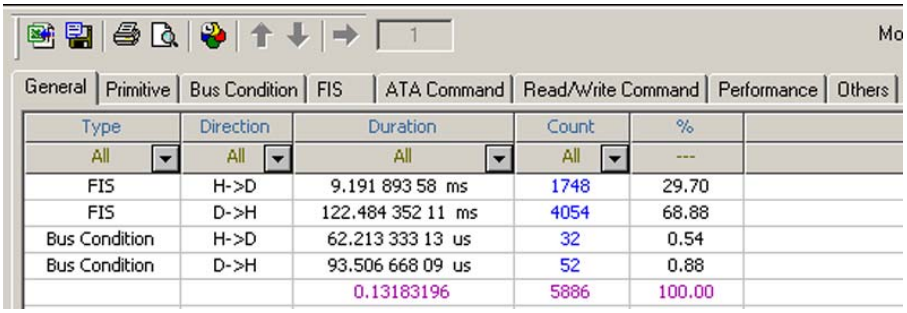
Report Options

Some report categories offer options to display only specific items.These report categories incorporate drop-down list boxes offering pre-defined and custom options. For details see "Formatting the Statistical Report View" on page 237.

General Report

To display the General Report, click the **General** tab. The General Report displays the report data in columns with the following information. See the following screen capture:

- Type: All, Custom, Bus Condition, FIS, Identify Address Frame, Open Address Frame, SMP Frame, SSP Frame, STP Frame
- **Direction**: All, H->D, D->H, I->T, T->I, or Custom
- **Duration**: All, Custom, or time unit
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count



Type	Direction	Duration	Count	%
All	All	All	All	---
FIS	H->D	9.191 893 58 ms	1748	29.70
FIS	D->H	122.484 352 11 ms	4054	68.88
Bus Condition	H->D	62.213 333 13 us	32	0.54
Bus Condition	D->H	93.506 668 09 us	52	0.88
		0.13183196	5886	100.00

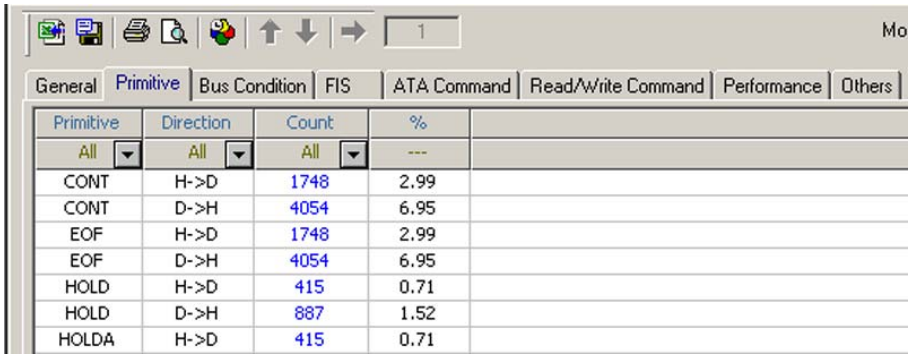
Figure 3.29: General Statistical Report

Primitive Report

To display the Primitive Report, click the **Primitive** tab. The Primitive Report displays information in the following columns (see Figure 3.30 on page 224):

- **Primitive**: All, Custom, Unknown
  For SATA: CONT, EOF, HOLD, HOLDA, R_IP, R_OK, R_RDY, SOF, SYNC, WTRM, X_RDY, ALIGN
  FOR SAS: SATA_CONT, SATA_EOF, SATA_R_IP, SATA_R_OK, SATA_R_RDY, SATA_SOF, SATA_SYNC, SATA_WTRM, SATA_X_RDY, ACK, EOF, SOF, EOAF, SOAF, AIP_WAITING_ON_DEVICE,AIP_NORMAL, DONE_NORMAL, READY_NORMAL, CLOSE_NORMAL, OPEN_ACCEPT, ALIGN0, ALIGN1, NOTIFY_ENABLE_SPINUP
- **Direction**: All, H->D, D->H, I->T, T->I, or Custom
- **Count**: All, Custom, or a number of occurrences

- **%**: of total count



General | Primitive | Bus Condition | FIS | ATA Command | Read/Write Command | Performance | Others

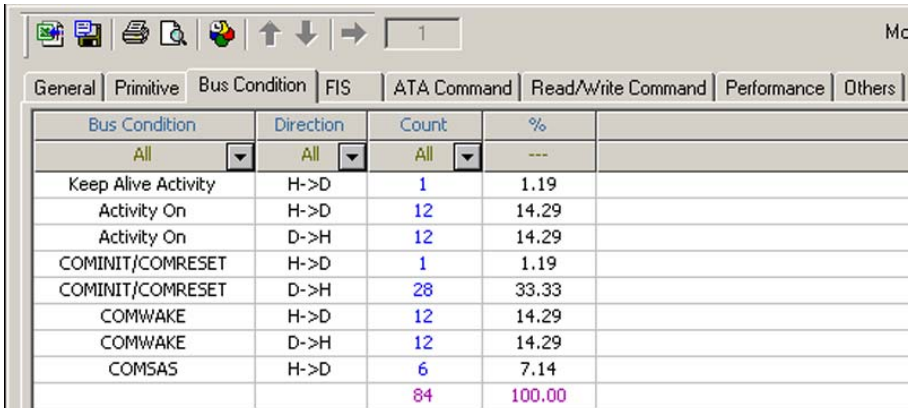
Primitive	Direction	Count	%
All	All	All	---
CONT	H->D	1748	2.99
CONT	D->H	4054	6.95
EOF	H->D	1748	2.99
EOF	D->H	4054	6.95
HOLD	H->D	415	0.71
HOLD	D->H	887	1.52
HOLDA	H->D	415	0.71

Figure 3.30: Primitive Report

Bus Condition Report

To display the Bus Condition Report, click the **Bus Condition** tab. The Bus Condition Report displays information in the following columns.

- Bus Condition: All, Custom, Activity On, COMINIT/COMRESET, COMSAS, COM-WAKE, Keep Alive Activity
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count



General | Primitive | Bus Condition | FIS | ATA Command | Read/Write Command | Performance | Others

Bus Condition	Direction	Count	%
All	All	All	---
Keep Alive Activity	H->D	1	1.19
Activity On	H->D	12	14.29
Activity On	D->H	12	14.29
COMINIT/COMRESET	H->D	1	1.19
COMINIT/COMRESET	D->H	28	33.33
COMWAKE	H->D	12	14.29
COMWAKE	D->H	12	14.29
COMSAS	H->D	6	7.14
		84	100.00

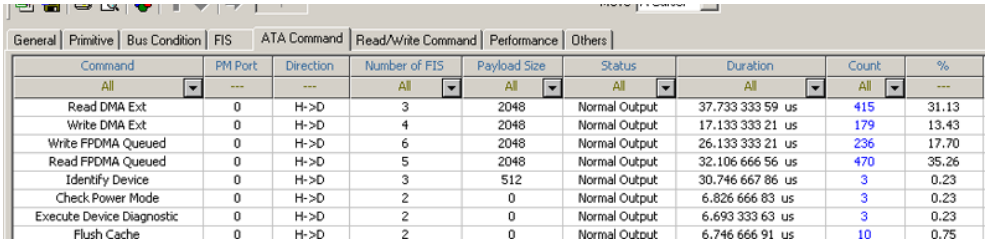
Figure 3.31: Bus Condition Report

ATA Command Report

To display the ATA Command Report, click the **ATA Command** tab (see Figure 3.32 on page 225.) The ATA Command Report displays information in the following columns:

- Command: All, Custom, Check Power Mode, Execute Device Diagnostic, Flush Cache, Identify Device, Read DMA Ext, Read FPDMA Queue, Set Feature, Write DMA Ext, Write FPDMA Queue
- PM Port
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- Number of FIS: All, Custom, or a number

- **Payload Size**: All, Custom, or a number of DWORDs
- Status: All, Custom, Incomplete, Normal Output
- Timeout: such as All, Custom, N/A, Yes and No (see "Time out of ATA Command Report" on page 225)
- **Duration**: All, Custom, or time unit
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count



General | Primitive | Bus Condition | FIS | ATA Command | Read/Write Command | Performance | Others

Command	PM Port	Direction	Number of FIS	Payload Size	Status	Duration	Count	%
All	---	---	All	All	All	All	All	---
Read DMA Ext	0	H->D	3	2048	Normal Output	37.733 333 59 us	415	31.13
Write DMA Ext	0	H->D	4	2048	Normal Output	17.133 333 21 us	179	13.43
Write FPDMA Queued	0	H->D	6	2048	Normal Output	26.133 333 21 us	236	17.70
Read FPDMA Queued	0	H->D	5	2048	Normal Output	32.106 666 56 us	470	35.26
Identify Device	0	H->D	3	512	Normal Output	30.746 667 86 us	3	0.23
Check Power Mode	0	H->D	2	0	Normal Output	6.826 666 83 us	3	0.23
Execute Device Diagnostic	0	H->D	2	0	Normal Output	6.693 333 63 us	3	0.23
Flush Cache	0	H->D	2	0	Normal Output	6.746 666 91 us	10	0.75

Figure 3.32: SATA: ATA Command Report

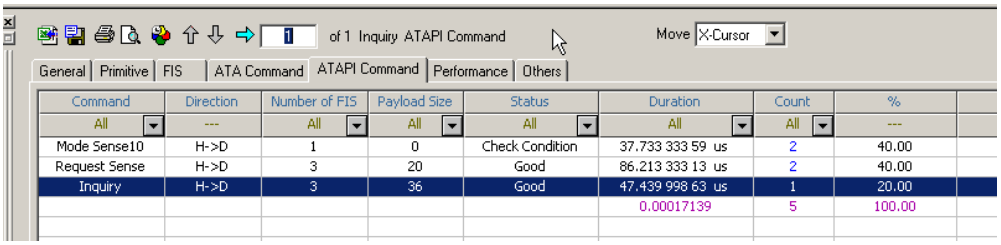
Time out of ATA Command Report

The Time out shows the NCQ time out. It is applicable for only NCQ commands. A threshold can be set in the "NCQ commands Timeout Threshold", the default value is 1000 µsec (the user can change it to any value). The statistical report provides a "Time out" report based on this threshold. Any NCQ command that takes more than the given threshold is flagged as "yes", which means that a timeout occurred for that command.

ATAPI Report

To display the ATAPI Report, click the **ATAPI** tab. The ATAPI Report displays information in the following columns (see the following screen capture):

- **Command**: All, Custom, Inquiry, Mode Sense 10, Read10, Request Sense
- **Direction**: All, H->D, D->H, or Custom
- **Number of FIS** or **Number of Transport**: All, Custom, or a number
- **Payload Size**: All, Custom, or a number of DWORDs
- **Status**: All, Custom, Check Condition, Good
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count



1 of 1 Inquiry ATAPI Command Move X-Cursor

General | Primitive | FIS | ATA Command | ATAPI Command | Performance | Others

Command	Direction	Number of FIS	Payload Size	Status	Duration	Count	%
All	---	All	All	All	All	All	---
Mode Sense10	H->D	1	0	Check Condition	37.733 333 59 us	2	40.00
Request Sense	H->D	3	20	Good	86.213 333 13 us	2	40.00
Inquiry	H->D	3	36	Good	47.439 998 63 us	1	20.00
					0.00017139	5	100.00

Figure 3.33: SATA: ATAPI Report

Protocol Error Report

To display the Protocol Error Report, click the **Protocol Error** tab. The Protocol Error Report displays the report data in columns with the following information:

- **Protocol Error**: All, Custom, Code Violation, CRC Error, Disparity Error, Align-Notify Error
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- Count: All, Custom, or a number of occurrences
- **%**: of total count

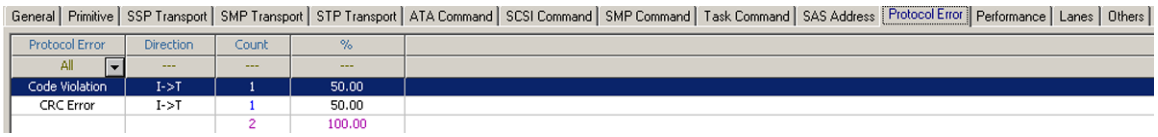


Figure 3.34: SAS: Protocol Error Report

Others Report

To display the Others Report, click the **Others** tab. The Others Report displays information in the following columns (see the following screen capture):

- Items
- Idle No: Number of idle packets
- Payload Size: Total number of payloads in trace files (SCSI + ATA commands)
- Sample Time: Sample time
- Idle (Initiator): Host idle time
- Idle (Target): Device idle time (total)
- SSP Bus Utilization: SSP bus utilization time (SSP frames)
- SMP Bus Utilization: SSP bus utilization time (SMP frames)
- STP Bus Utilization: SSP bus utilization time (STP frames)
- Count or Time

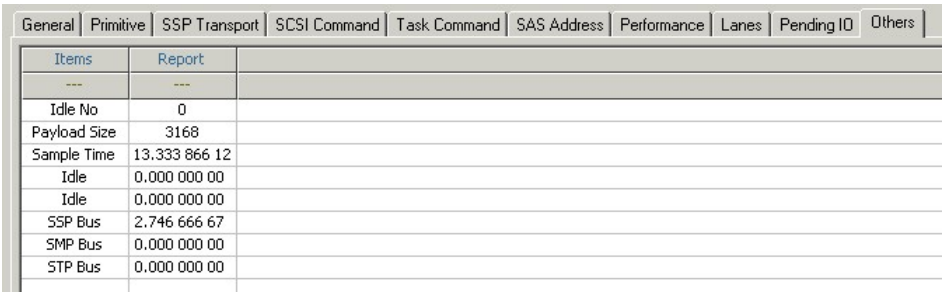


Figure 3.35: Others Report

SSP Transport Report (SAS)

To display the SSP Transport Report, click the **SSP Transport** tab. The SSP Transport Report displays the report data in columns with the following information (see Figure 3.36 on page 227):

- Type: All, Custom, Command, Data, Response, XFER_RDY

- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

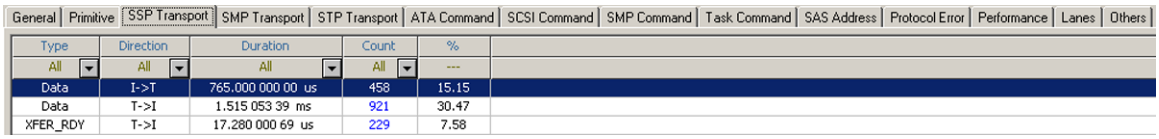

General Primitive SSP Transport SMP Transport STP Transport ATA Command SCSI Command SMP Command Task Command SAS Address Protocol Error Performance Lanes Others
Type Direction Duration Count %
All All All All ---
Data I->T 765.000 000 00 us 458 15.15
Data T->I 1.515 053 39 ms 921 30.47
XFER_RDY T->I 17.280 000 69 us 229 7.58

Figure 3.36: SAS: SSP Transport Report

SMP Transport Report (SAS)

To display the SMP Transport Report, click the **SMP Transport** tab. The SMP Transport Report displays the report data in columns with the following information :

- Type: All, Custom, Request, Response
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

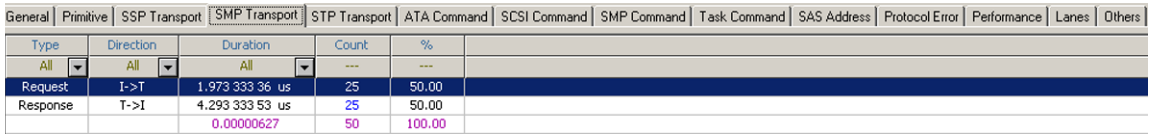

General Primitive SSP Transport SMP Transport STP Transport ATA Command SCSI Command SMP Command Task Command SAS Address Protocol Error Performance Lanes Others
Type Direction Duration Count %
All All All --- ---
Request I->T 1.973 333 36 us 25 50.00
Response T->I 4.293 333 53 us 25 50.00
0.00000627 50 100.00

Figure 3.37: SAS: SMP Transport Report

STP Transport Report (SAS)

To display the STP Transport Report, click the **STP Transport** tab. The STP Transport Report displays the report data in columns with the following information:

- FIS Type: All, Custom, Data, PIO Setup, Register Host To Device, Register Device To Host
- PM Port
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

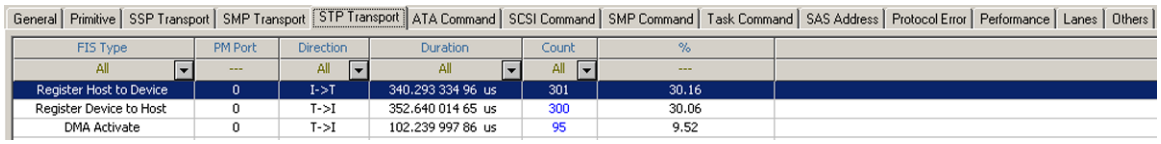
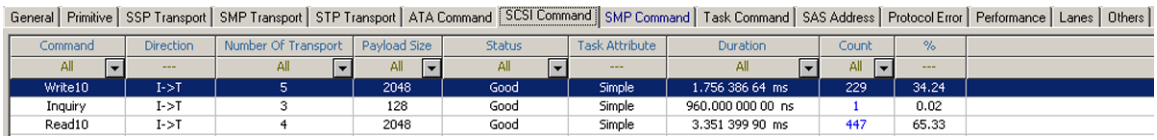

General Primitive SSP Transport SMP Transport STP Transport ATA Command SCSI Command SMP Command Task Command SAS Address Protocol Error Performance Lanes Others
FIS Type PM Port Direction Duration Count %
All --- All All All ---
Register Host to Device 0 I->T 340.293 334 96 us 301 30.16
Register Device to Host 0 T->I 352.640 014 65 us 300 30.06
DMA Activate 0 T->I 102.239 997 86 us 95 9.52

Figure 3.38: SAS: STP Transport Report

SCSI Command Report (SAS)

To display the SCSI Command Report, click the **SCSI Command** tab. The SCSI Command Report displays (see Figure 3.39 on page 228) the report data in columns with the following information:

- Command: All, Custom, Inquiry, Mode Sense6, Pause Resume, Play Audio 10, Read Capacity, Read10, Receive Diagnostic Results, Send Diagnostic, Write10, Start Stop Unit, Test Unit Ready, Report Luns, Synchronize Cache10
- Direction: All, I->T, T->I, or Custom
- Number of Transport: All, Custom, or a number
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good, Incomplete, Response Data Present
- Task Attribute: Simple
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- %: of total count



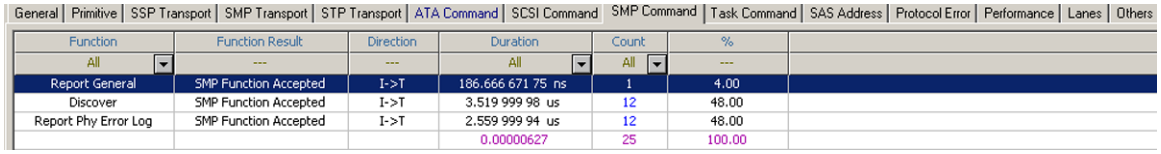
Command	Direction	Number Of Transport	Payload Size	Status	Task Attribute	Duration	Count	%
All	---	All	All	All	---	All	All	---
Write10	I->T	5	2048	Good	Simple	1.756 386 64 ms	229	34.24
Inquiry	I->T	3	128	Good	Simple	960.000 000 00 ns	1	0.02
Read10	I->T	4	2048	Good	Simple	3.351 399 90 ms	447	65.33

Figure 3.39: SAS: SCSI Command Report

SMP Command Report (SAS)

To display the SMP Command Report, click the **SMP Command** tab. The SMP Command Report displays the report data in columns with the following information:

- Function: All, Custom, Discover, Report General, Report Manufacture Information, Report PHY Error Log
- Function Result: SMP Function Accepted
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count



Function	Function Result	Direction	Duration	Count	%
All	---	---	All	All	---
Report General	SMP Function Accepted	I->T	186.666 671 75 ns	1	4.00
Discover	SMP Function Accepted	I->T	3.519 999 98 us	12	48.00
Report Phy Error Log	SMP Function Accepted	I->T	2.559 999 94 us	12	48.00
			0.00000627	25	100.00

Figure 3.40: SAS: SMP Command Report

Task Command Report (SAS)

To display the Task Command Report, click the **TASK Command** tab. The Task Command Report displays the report data in columns with the following information (see Figure 3.41 on page 229):

- Function

- Status
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

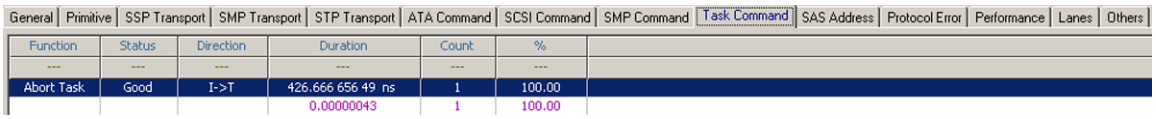


Figure 3.41: SAS: TASK Command Report

SAS Address Report (SAS)

To display the SAS Address Report, click the **SAS Address** tab.The SAS Address Report displays the report data in columns with the following information:

- Source SAS Address: All, Custom, or an address
- Destination SAS Address: All, Custom, or an address
- Protocol Type: SMP, SSP, STP
- Frame Type: All, Custom, Command, Data, DMA Activate, Register Host To Device, Register Device To Host, Response, XFER_RDY
- **Count**: All, Custom, or a number

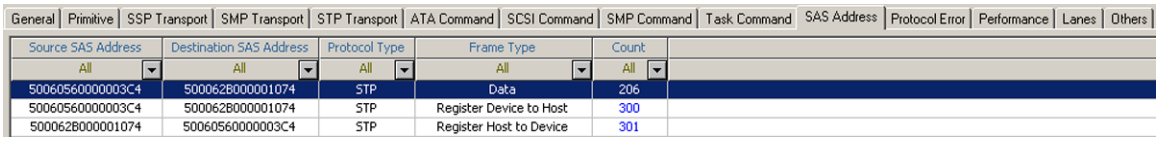


Figure 3.42: SAS: SAS Address Report

Lanes Report (SAS)

To display the Lanes Report, click the **Lanes** tab. The Lanes Report displays the report data in columns with the following information (see Figure 3.43 on page 230):

- Port
- Open Accept: All, Custom, or a number
- Open Reject: All, Custom, or a number
- AIP Waiting on Con.
- Break
- SCSI Command: All, Custom, or a number
- ATA Command: All, Custom, or a number
- SMP Command: All, Custom, or a number
- Out Standing Command: All, Custom, or a number
- Transfer Bytes: All, Custom, or a number
- Link Utilization (time)
- Link Utilization %

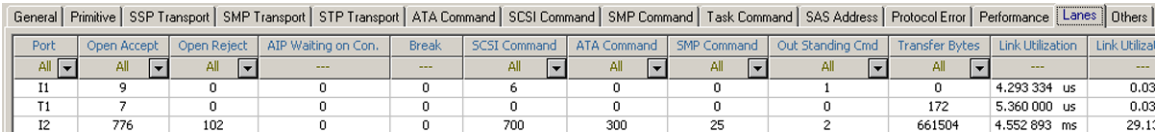


Figure 3.43: SAS Lanes Report

Read/Write Command Report (SAS)

To display the Read/Write Command Report, click the **Read/Write Command** tab. You can enable or disable creation of this page under **Preferences** (see "Preferences" on page 296). The Read/Write Command report displays the report data in columns with the following information:

- Source SAS Address
- Destination SAS Address
- Protocol Type
- OpCode/Command
- Tag
- LBA
- Sector Count
- Xfer Length
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good
- Completion Time
- Performance
- Standard Deviation
- **Count**: All, Custom, or a number

Figure 3.44: SAS: Read Write Command Report

Performance Report (SAS)

To display the Performance Report, click the **Performance** tab (see Figure 3.45 on page 231). The Performance Report displays the report data in columns with the following information:

- Minimum Completion Time
- Average Completion Time
- Maximum Completion Time
- Initiator Bus Utilization
- Target Bus Utilization
- Efficiency
- Total Read Cmd
- Total Read (Bytes)
- Total Read Duration

- Cmd Minimum Read (MB/S)
- Cmd Average Read (MB/S)
- Cmd Maximum Read (MB/S)
- Total Write Cmd
- Total Write (Bytes)
- Total Write Duration is the sum of all write commands duration.
- Cmd Minimum Write (MB/S)
- Cmd Average Write (MB/S) is the Total Write (Total payload size of all write commands in sample file in MB) / Total Completion Time (Total completion time of all write commands in sample file in seconds).
- Cmd Maximum Write (MB/S)
- Average Byte per SSP Frame
- Average Byte per STP Frame

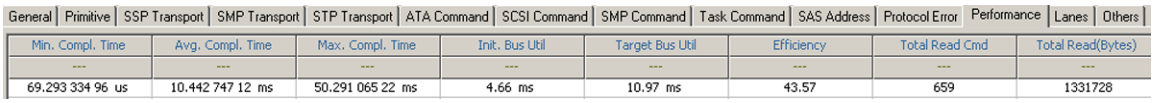


Figure 3.45: SAS: Performance Report

Performance Report (SATA)

To display the Performance Report, click the **Performance** tab. The Performance Report displays information in the following columns (see Figure 3.46 on page 232):

- Minimum Completion Time
- Average Completion Time
- Maximum Completion Time
- Host Bus Utilization
- Device Bus Utilization
- Efficiency (%)
- Total Read Cmd
- Total Read (Bytes)
- Total Read Duration
- Cmd Minimum Read (MB/S)
- Cmd Average Read (MB/S)
- Cmd Maximum Read (MB/S)
- Total Write Cmd
- Total Write (Bytes)
- Total Write Duration is the sum of all write commands duration.
- Cmd Minimum Write (MB/S)
- Cmd Average Write (MB/S) is the Total Write (Total payload size of all write commands in sample file in MB) / Total Completion Time (Total completion time of all write commands in sample file in seconds).
- Cmd Maximum Write (MB/S)
- Average Byte Per FIS
- FIS Minimum Difference Time
- FIS Average Difference Time is the difference between two back to back FIS in the same link and is the average.
- FIS Maximum Difference Time

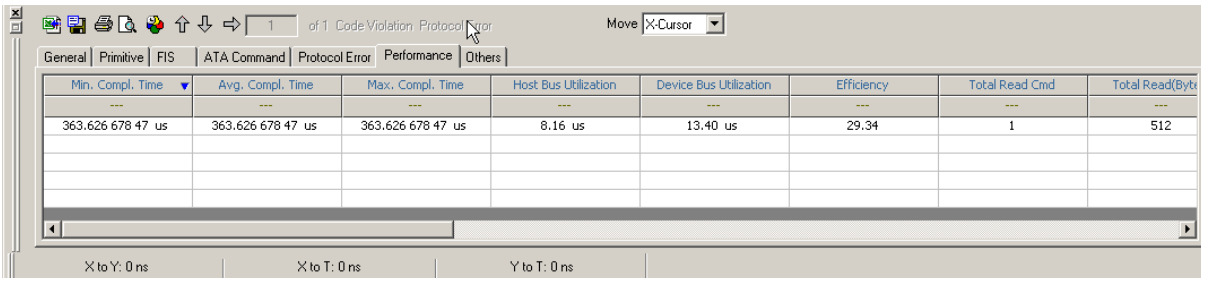


Figure 3.46: SATA: Performance Report

FIS Report (SATA)

To display the FIS Report, click the **FIS** tab. The FIS Report displays information in the following columns:

- **FIS Type**: All, Custom, Data, PIO Setup, Register Host To Device, Register Device To Host
- PM Port
- **Direction**: All, H->D, D->H, or Custom
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count

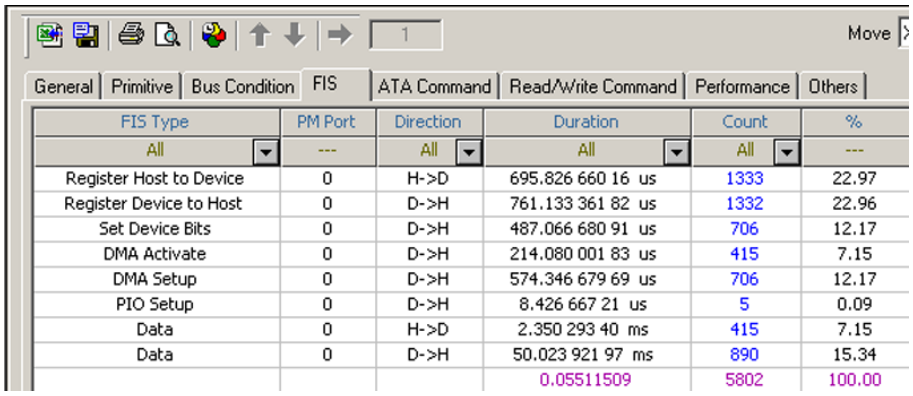

Move
General Primitive Bus Condition FIS ATA Command Read/Write Command Performance Others
FIS Type
PM Port
Direction
Duration
Count
%
All
All
All
Register Host to Device 0 H->D 695.826 660 16 us 1333 22.97
Register Device to Host 0 D->H 761.133 361 82 us 1332 22.96
Set Device Bits 0 D->H 487.066 680 91 us 706 12.17
DMA Activate 0 D->H 214.080 001 83 us 415 7.15
DMA Setup 0 D->H 574.346 679 69 us 706 12.17
PIO Setup 0 D->H 8.426 667 21 us 5 0.09
Data 0 H->D 2.350 293 40 ms 415 7.15
Data 0 D->H 50.023 921 97 ms 890 15.34
0.05511509 5802 100.00

Figure 3.47: SATA: FIS Report

Queue Command Report (SATA)

To display the Queue Command Report, click the **Queue Command** tab (see Figure 3.48 on page 233). The Queue Command Report displays information in the following columns:

- **Command**: All, Custom, Read DMA Queued
- PM Port
- **Status**: All, Custom, Normal Output
- **Payload Size**: All, Custom, or a number of DWORDs
- **Direction**: All, H->D, D->H, or Custom
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count

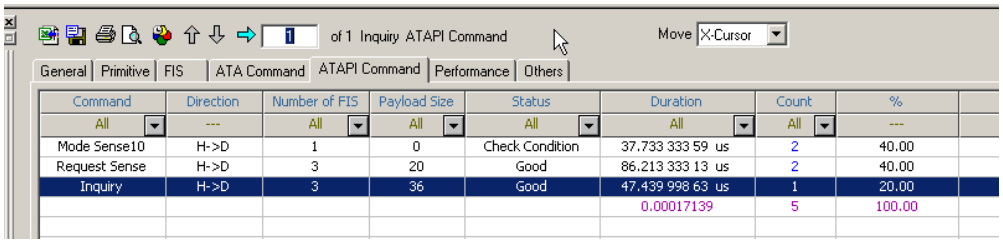

1 of 1 Inquiry ATAPI Command
Move X-Cursor
General Primitive FIS ATA Command ATAPI Command Performance Others
Command Direction Number of FIS Payload Size Status Duration Count %
All --- All All All All All ---
Mode Sense10 H->D 1 0 Check Condition 37.733 333 59 us 2 40.00
Request Sense H->D 3 20 Good 86.213 333 13 us 2 40.00
Inquiry H->D 3 36 Good 47.439 998 63 us 1 20.00
0.00017139 5 100.00

Figure 3.48: SATA: Queue Command Report

PM Statistic Report (SATA)

To display the PM Statistic Report, click the **PM Statistic** tab. The PM Statistic Report displays information in the following columns:

- Request Type: PMREQ_P
- Request Port
- Response Type: All, Custom, PMACK
- Response Time
- Request Entering Delay
- Response Entering Delay
- Wakeup Type
- Request DC Idle Time
- Response DC Idle Time
- Request Wakeup Time
- Response Wakeup Time
- **Count**: All, Custom, or a number

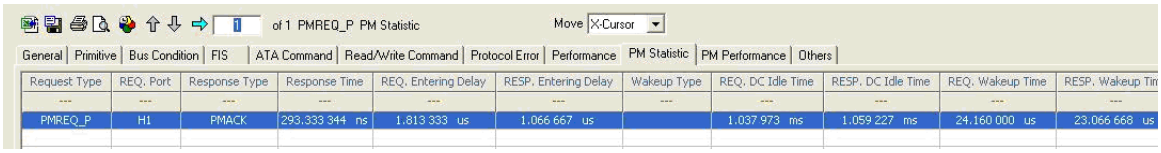

1 of 1 PMREQ_P PM Statistic
Move X-Cursor
General Primitive Bus Condition FIS ATA Command Read/Write Command Protocol Error Performance PM Statistic PM Performance Others
Request Type REQ. Port Response Type Response Time REQ. Entering Delay RESP. Entering Delay Wakeup Type REQ. DC Idle Time RESP. DC Idle Time REQ. Wakeup Time RESP. Wakeup Tim
PMREQ_P H1 PMACK 293.333 344 ns 1.813 333 us 1.066 667 us 1.037 973 ms 1.059 227 ms 24.160 000 us 23.066 668 us

Figure 3.49: SATA: PM Statistic Report

PM Performance Report (SATA)

To display the PM Performance Report, click the **PM Performance** tab. The PM Performance Report displays (see Figure 3.50 on page 234) information in the following columns:

- Port
- Partial Request
- Partial ACKed
- Partial NACKed
- Slumber Request
- Slumber ACKed
- Slumber NACKed
- Partial Time / Slumber Time %
- Partial Time / Total Time %
- Slumber Time / Total Time %

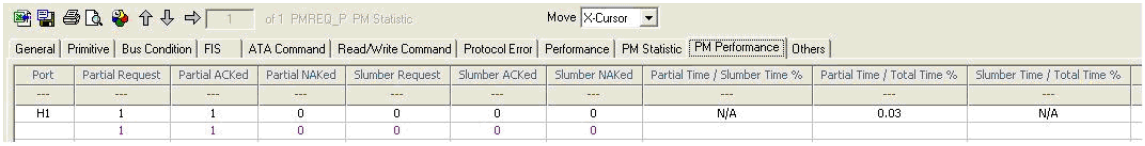

Move X-Cursor
General Primitive Bus Condition FIS ATA Command Read/Write Command Protocol Error Performance PM Statistic PM Performance Others
Port Partial Request Partial ACKed Partial NAKed Slumber Request Slumber ACKed Slumber NAKed Partial Time / Slumber Time % Partial Time / Total Time % Slumber Time / Total Time %
H1 1 1 0 0 0 0 N/A 0.03 N/A

Figure 3.50: SATA: PM Performance Report

Read Write Command Report (SATA)

To display the Read/Write Command Report, click the **Read/Write Command** tab. You can enable or disable creation of this page under **Preferences** (see "Preferences" on page 296). The Read/Write Command Report displays information in the following columns:

- Time Stamp
- OpCode/Command
- LBA
- Sector Count
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good
- Completion Time
- **Count**: All, Custom, or a number

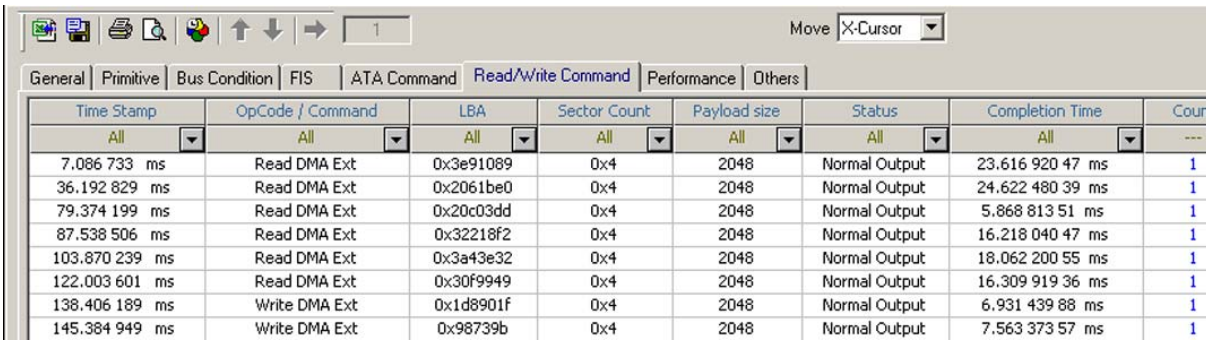

Move X-Cursor
General Primitive Bus Condition FIS ATA Command Read/Write Command Performance Others
Time Stamp OpCode / Command LBA Sector Count Payload size Status Completion Time
7.086 733 ms Read DMA Ext 0x3e91089 0x4 2048 Normal Output 23.616 920 47 ms 1
36.192 829 ms Read DMA Ext 0x2061be0 0x4 2048 Normal Output 24.622 480 39 ms 1
79.374 199 ms Read DMA Ext 0x20c03dd 0x4 2048 Normal Output 5.868 813 51 ms 1
87.538 506 ms Read DMA Ext 0x32218f2 0x4 2048 Normal Output 16.218 040 47 ms 1
103.870 239 ms Read DMA Ext 0x3a43e32 0x4 2048 Normal Output 18.062 200 55 ms 1
122.003 601 ms Read DMA Ext 0x30f9949 0x4 2048 Normal Output 16.309 919 36 ms 1
138.406 189 ms Write DMA Ext 0x1d8901f 0x4 2048 Normal Output 6.931 439 88 ms 1
145.384 949 ms Write DMA Ext 0x98739b 0x4 2048 Normal Output 7.563 373 57 ms 1

Figure 3.51: SATA: Read Write Command Report

3.3.11 Statistical Report Toolbar

The Statistical Report toolbar provides the following functions accessible by buttons on the toolbar:

- Export to Excel
- Save as Text
- Print Report
- Print Preview
- Report Display Settings
- Move to **X-Cursor, Y-Cursor**, or **None**

Export as Microsoft® Excel file

The **Export to Excel** button opens the Export to Excel dialog. Choose a folder in which to save the Excel file, choose an appropriate file name, and click **Save.**

Save as Text file

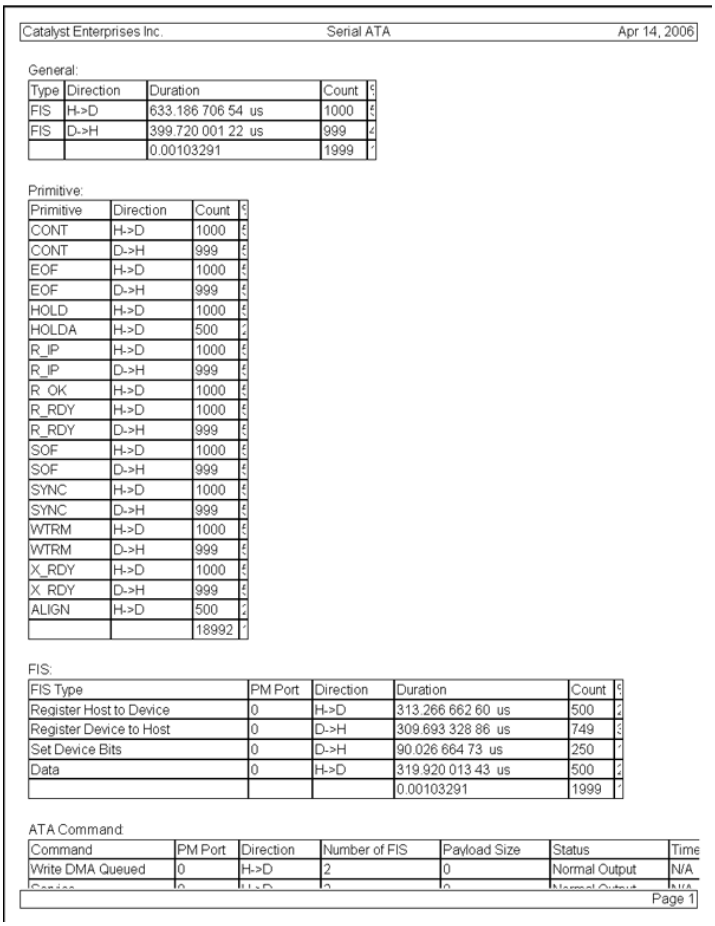
The **Save as Text** button opens the Export to Text dialog. Choose a folder in which to save the Text file, choose an appropriate file name, and click **Save.**

Print Statistical Report

The **Print** button opens the select printer dialog. Choose an available printer and click **OK.**

Print Preview

The **Print Preview** button displays a preview of the report to print**.**



Catalyst Enterprises Inc. Serial ATA Apr 14, 2006

General:

Type	Direction	Duration	Count
FIS	H->D	633.186 706 54 us	1000
FIS	D->H	399.720 001 22 us	999
		0.00103291	1999

Primitive:

Primitive	Direction	Count
CONT	H->D	1000
CONT	D->H	999
EOF	H->D	1000
EOF	D->H	999
HOLD	H->D	1000
HOLDA	H->D	500
R_IP	H->D	1000
R_IP	D->H	999
R_OK	H->D	1000
R_RDY	H->D	1000
R_RDY	D->H	999
SOF	H->D	1000
SOF	D->H	999
SYNC	H->D	1000
SYNC	D->H	999
WTRM	H->D	1000
WTRM	D->H	999
X_RDY	H->D	1000
X_RDY	D->H	999
ALIGN	H->D	500
		18992

FIS:

FIS Type	PM Port	Direction	Duration	Count
Register Host to Device	0	H->D	313.266 662 60 us	500
Register Device to Host	0	D->H	309.693 328 86 us	749
Set Device Bits	0	D->H	90.026 664 73 us	250
Data	0	H->D	319.920 013 43 us	500
			0.00103291	1999

ATA Command:

Command	PM Port	Direction	Number of FIS	Payload Size	Status	Time
Write DMA Queued	0	H->D	2	0	Normal Output	N/A

Page 1

Figure 3.52: Sample Print Preview of Report

Report Display Settings

The **Setting** button opens the Setting dialog.

You can set up the report columns for display to suit a particular analysis need, eliminating the need to show/hide columns individually. Use the **Setting** dialog to configure the display for each page.

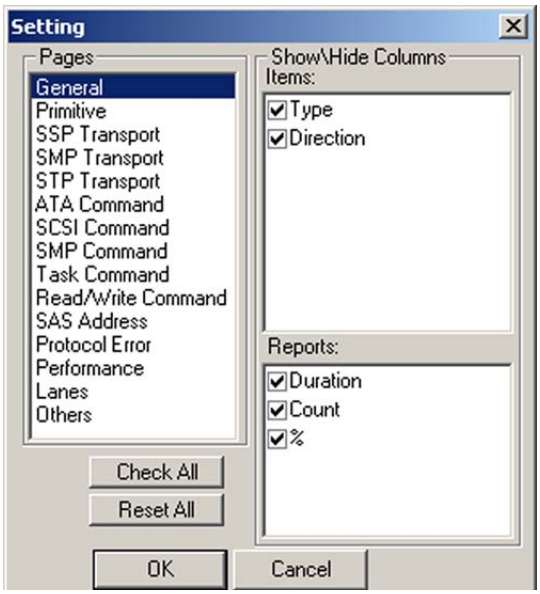


Figure 3.53: SAS: Statistical Report Column Setting

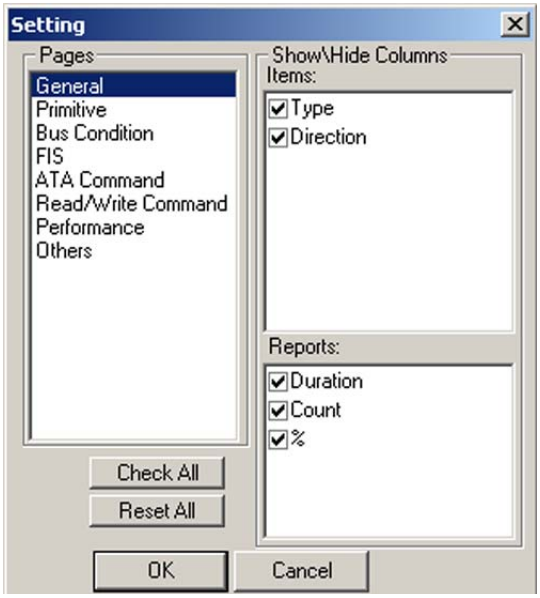


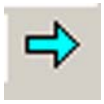
Figure 3.54: SATA: Statistical Report Column Setting

Link With Sample View

When you select a type on any page of the Statistical Report, a set of navigation buttons allows you to examine each instance of that type in the Sample Viewer.

The **Jump to Previous** button goes to the previous instance of the selected type in the Sample Viewer**.**

The **Jump to Next** button goes to the next instance of the selected type in the Sample Viewer**.**



The **Jump to Specific** button goes to the instance specified as N of M items on the Statistical Report toolbar**.**

The **Move** drop-down list moves to the X-Cursor, Y-Cursor, or None**.**

3.3.12 Formatting the Statistical Report View

Initially the Statistical Report View contains all of the information in columns, but you can customize the display by:

- Filtering columns by item
- Sorting items by column
- Hiding any column on the display

Filtering Column Content

To filter column content, click the down arrow in the heading for that column and choose the items to display. The default is All. By checking a specific item, you exclude everything but that item for display (see Figure 3.55 on page 238).

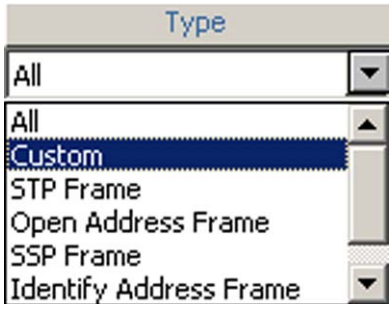


Figure 3.55: SAS: Type

Choosing **Custom** allows you to specify more than one item for display (see Figure 3.56 on page 238).

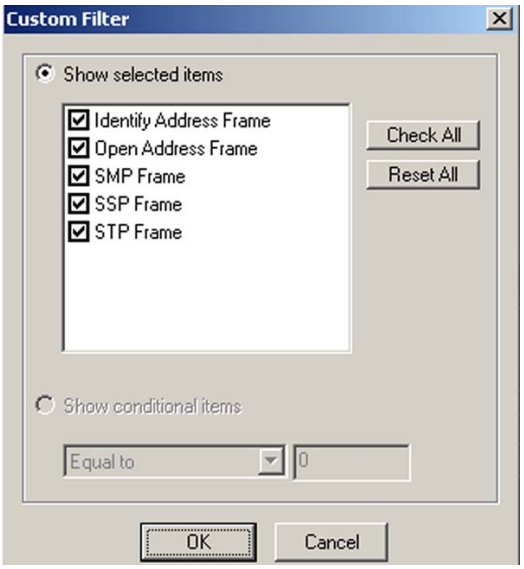


Figure 3.56: SAS: Custom Filter

.

Figure 3.57: SATA: FIS Type

Choosing **Custom** allows you to specify more than one item for display (see Figure 3.58 on page 239).

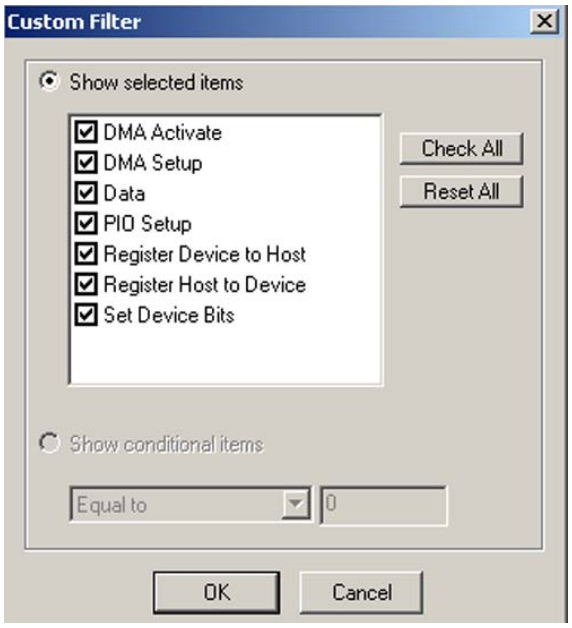


Figure 3.58: SATA: Custom Filter

Check the items to display and click **OK**.

Sorting Column Content

To sort column content, click the **heading** for that column. Repeated clicking of the column heading sorts the column in ascending or descending order.

Type	Direction	Duration	Count	%
All	All	All	All	---
Open Address Frame	I->T	18.39999962 us	69	28.51
SMP Frame	T->I	4.53333330 us	17	7.02
SMP Frame	I->T	1.81333339 us	17	7.02
SSP Frame	T->I	23.12000084 us	53	21.90
SSP Frame	I->T	14.48000050 us	35	14.46
STP Frame	T->I	85.89333344 us	34	14.05
STP Frame	I->T	7.03999996 us	17	7.02
		0.00015528	242	100.00

Type	Direction	Duration	Count	%
All	All	All	All	---
STP Frame	I->T	7.03999996 us	17	7.02
STP Frame	T->I	85.89333344 us	34	14.05
SSP Frame	I->T	14.48000050 us	35	14.46
SSP Frame	T->I	23.12000084 us	53	21.90
SMP Frame	I->T	1.81333339 us	17	7.02
SMP Frame	T->I	4.53333330 us	17	7.02
Open Address Frame	I->T	18.39999962 us	69	28.51
		0.00015528	242	100.00

Figure 3.59: Toggling Type Sort Order

Hiding Columns

To hide a column, right-click in the column and choose **Hide**. To unhide a column, right-click any column and choose **Unhide**.

3.3.13 Histogram View

The Histogram View displays a histogram of frame-type transfers.

To display the Histogram View of the current capture, click **View > Histogram View** or click the button on the View Type toolbar.

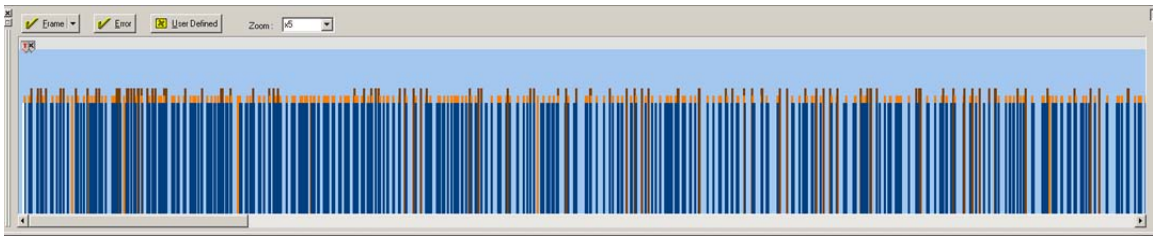


Figure 3.60: Histogram View

Hide Frames

You can customize the histogram by including only frame types that you want.

To choose frame types to include in the display, click the down arrow on the **Frame** button on the Histogram toolbar and check frame types:

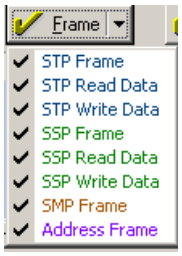


Figure 3.61: SAS: Histogram Frames

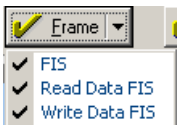


Figure 3.62: SAS: Histogram Frames

Hide Error Frames

Frames with errors are displayed in red. To hide error frames from the histogram, click the button.

Note: To display the error code of a protocol error, click the error icon (with the red 'x').

Pending IO Graph

The Tool menu has a Pending IO Graph command, with horizontal zoom, vertical zoom, click and drag zoom, graph area zoom, synchronize with trace view, fit to graph area and graph view.

User Defined

You can define additional items for inclusion in the Histogram by clicking the

button to open the User Defined dialog. See the following screen capture:

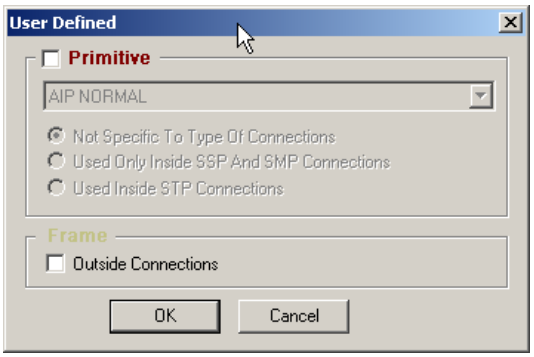


Figure 3.63: SAS: Histogram User Defined Dialog

You can include Primitive and/or Outside Connections frames.

Primitives

To include Primitives, check the **Primitive** check box, click the down arrow on the Primitive list box, and choose a Primitive.

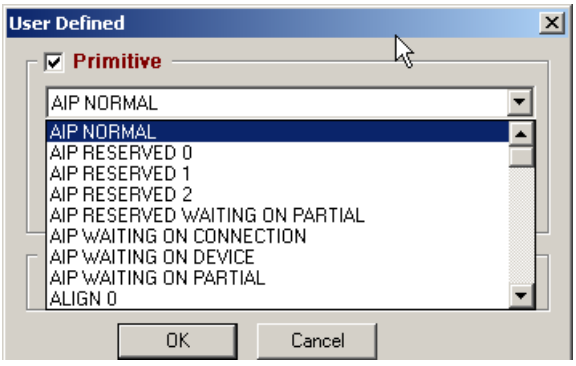


Figure 3.64: SAS: Choosing a Primitive

.

Figure 3.65: SATA: Choosing a Primitive

Check a Connection Type option radio button, if available, and click **OK**.

Zoom

You can Zoom from x1 to x256.

3.3.14 Bus Utilization View

The Bus Utilization View displays information on pending IO. To display the Bus Utilization View of the current capture,

click **View > Bus Utilization View** or click the button on the View Type toolbar.

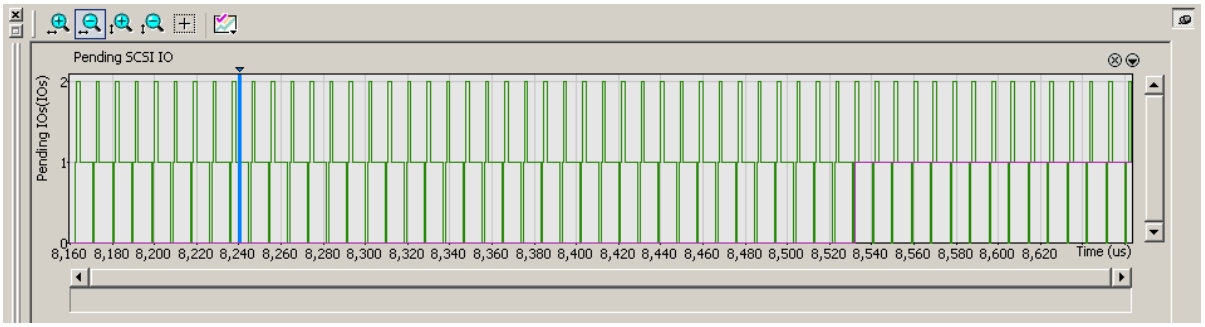


Figure 3.66: SAS: Bus Utilization View for Pending SCSI IO

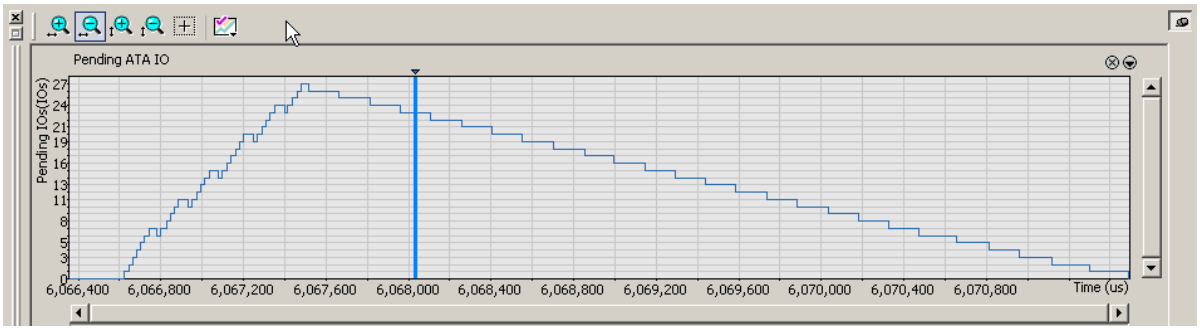


Figure 3.67: SATA: Bus Utilization View for Pending ATA IO

Available Bus Utilization Views are:

- Pending SCSI IO (for SAS)
- Pending ATA IO (for SATA)

Hovering the mouse over the graph heading displays the graph legend:

- **Go to ATA/SCSI Cmd. #**: Jump to command.
- **Synchronize with Trace View**: Synchronize all open views to that location in the trace.
- **Fit to Graph Area**: Zoom to fit.
- **Hide**: Do not display the graph.

To synchronize all open views to that location in the trace, double-click the graph.

3.3.15 Bus Utilization Buttons

The Bus Utilization window has a row of buttons for changing the format of the displayed data. The buttons have the following functions:

	Horizontal zoom in		Vertical zoom in
	Horizontal zoom out		Vertical zoom out
	Graph Areas Presents options for displaying additional graphs.		Click and Drag zoom Click diagonally to select and zoom in on part of the graph.
	Hide graph.		Graph legend (see previous page)

3.4 Data Report

When a captured sample is in the Sample Viewer, the Data Report button is on the Viewer toolbar, and Data Report is in the Report menu.

The data report displays all the data sent from the host to the device and from the device to the host. All PIO In =>In commands are grouped as a data packet until the occurrence of a PIO Out =>Out command, creating a new data packet.

To display a Data Report, click the **Data Report** button on the Viewer toolbar or select **Report > Data Report**.

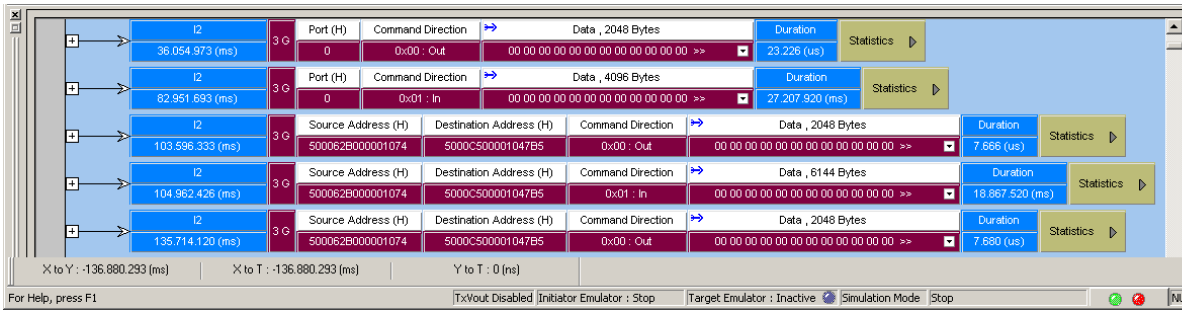


Figure 3.68: SAS: Data Report

Click the **Down Arrow** in a data field to display Data Report details (see the following screen capture.)

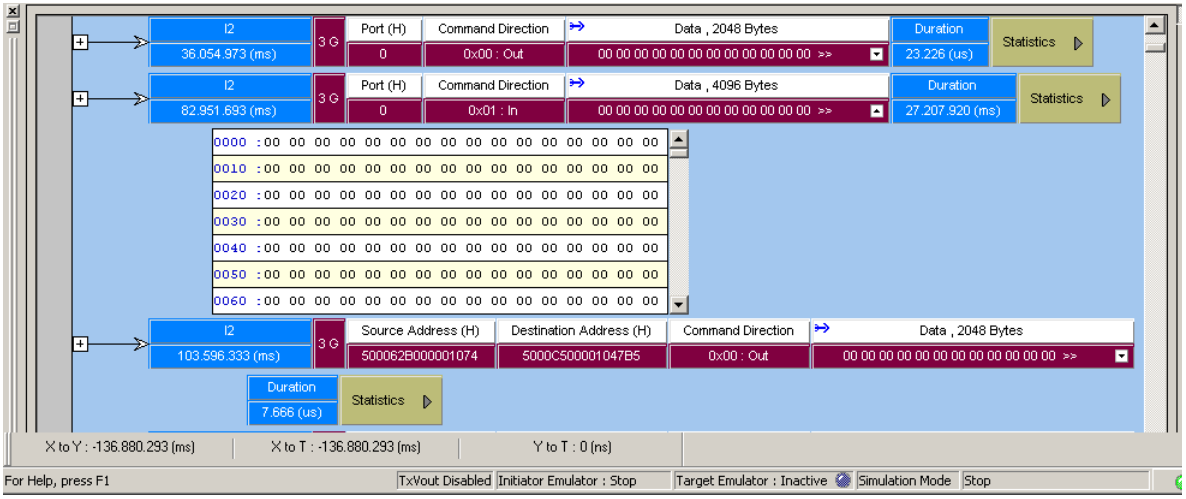


Figure 3.69: SAS: Data Report Details

Click the **Statistics** button at the end of a row to display data report statistics.

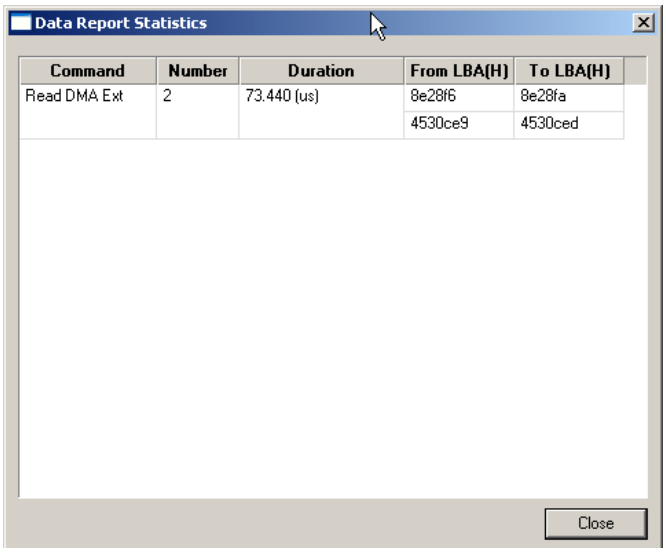


Figure 3.70: SAS: Data Report Statistics

3.4.1 Data Payload View

To display the Data Payload View (see Figure 3.71 on page 245), double-click a data payload field in a Packet or Spreadsheet view, or right-click a data payload field and select **Open as Data View**:

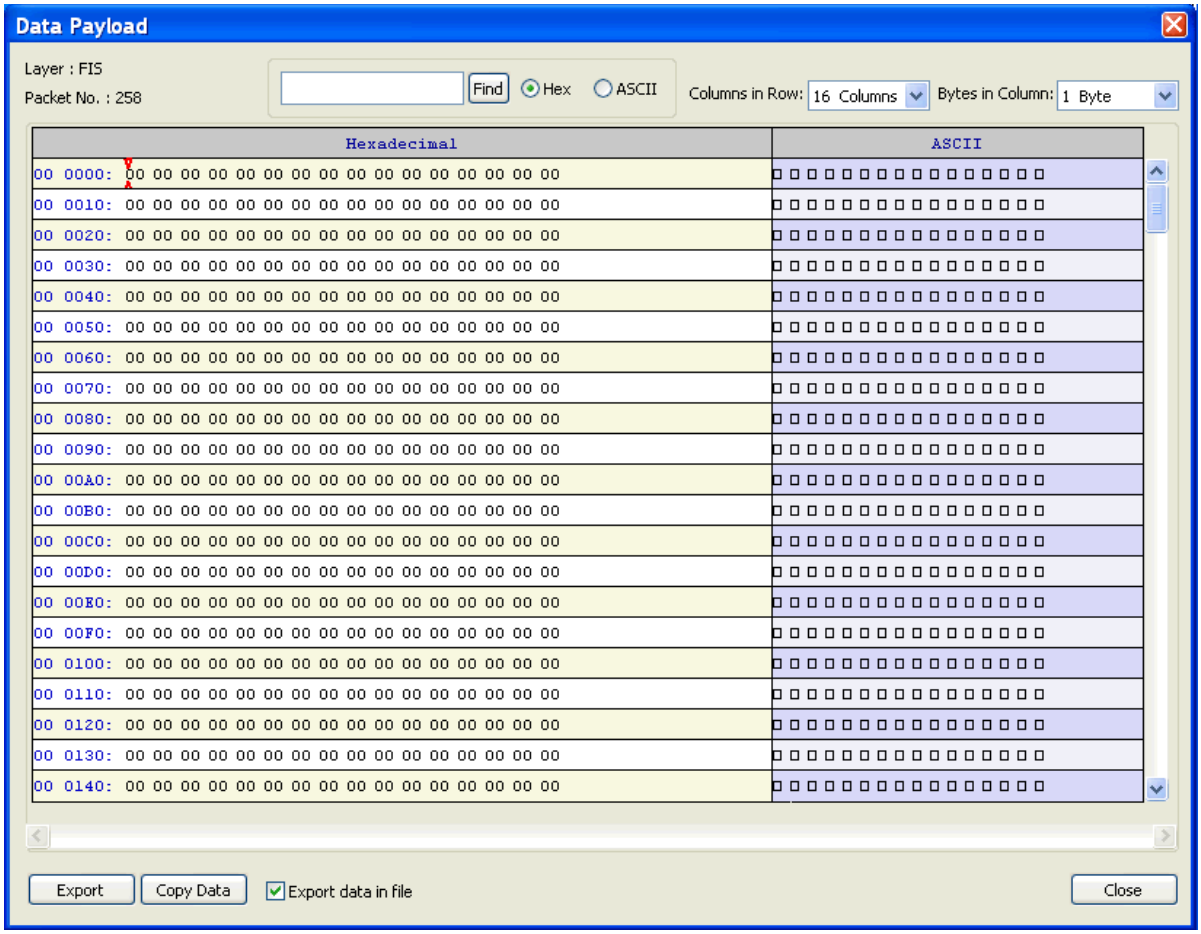


Figure 3.71: Data Payload View

Note: When showing truncated data in the Data Payload View, the truncation points are marked with a separator placed between payloads. You can get more information about the data exclusion using the tooltip over the separator.

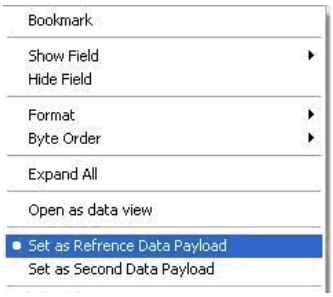
Note: You can control the number of bytes per line.

Find Data Pattern

To quickly locate a data pattern in the current frame, enter the pattern in the Text Box and click the **Find** button.

3.4.2 Compare Two Data Payloads

To compare two data payloads, select two different payload packets, one as reference. Right-click a payload field in Packet View or a related frame in Text View or Spreadsheet View to display a menu, then select **Set As Reference Data Payload**.



Right-click a payload field in Packet View or a related frame in Text View or Spreadsheet View to display a menu, and choose **Set as Second Data Payload**.

To compare data payloads, click the **Show/Hide Compare 2 Data Payloads** button on the View Type toolbar:

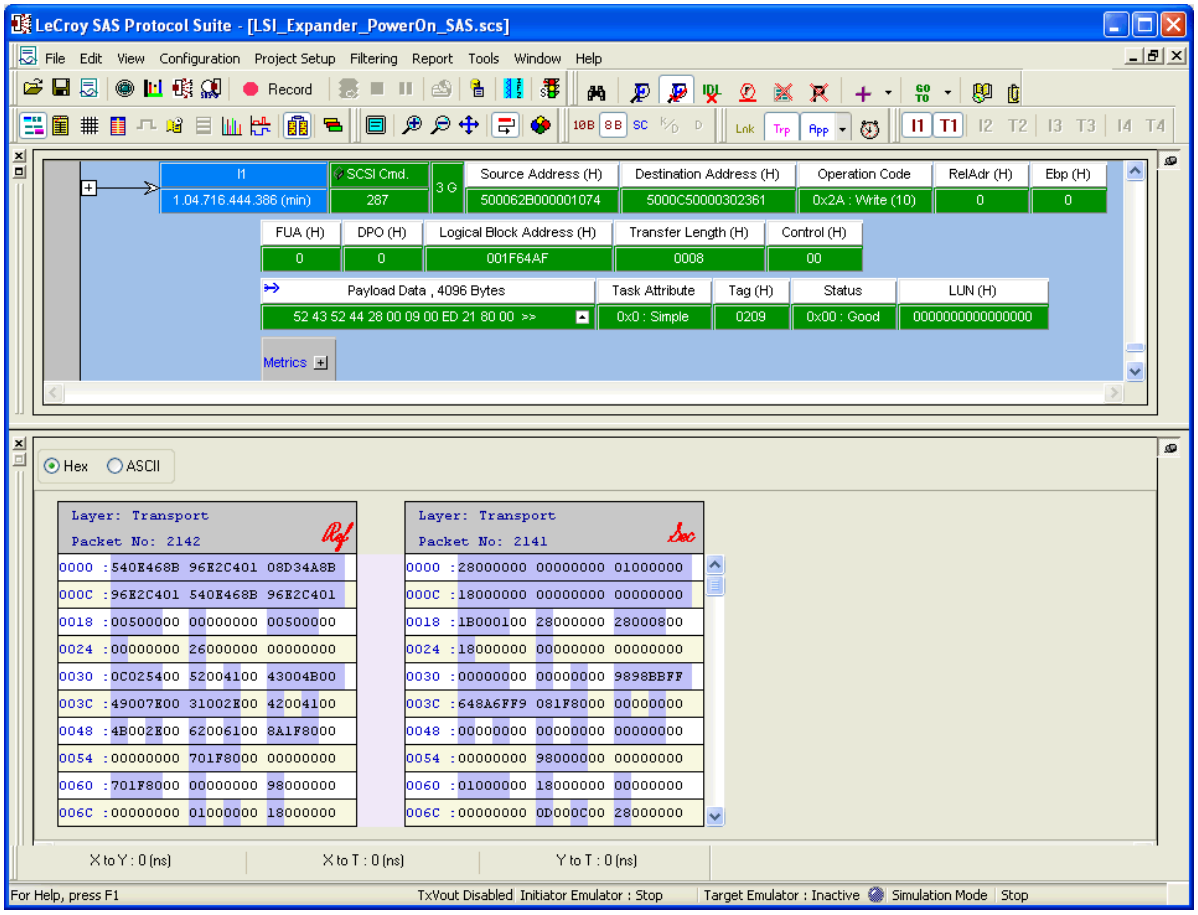


Figure 3.72: Compare Two Data Payloads

3.4.3 Power Tracker View (SATA only)

Click the **Power Tracker View** button on the Viewer toolbar or select **Analysis > Power Tracker View**. The Power Tracker View displays all the power, current and voltage information captured while recording a trace as well as the sample time. See “Power Management Setting (SATA only)” on page 105 for more information.

The power, voltage and current is displayed on the vertical axis and time on the horizontal axis. Hover anywhere over the view to display the information pop-up.

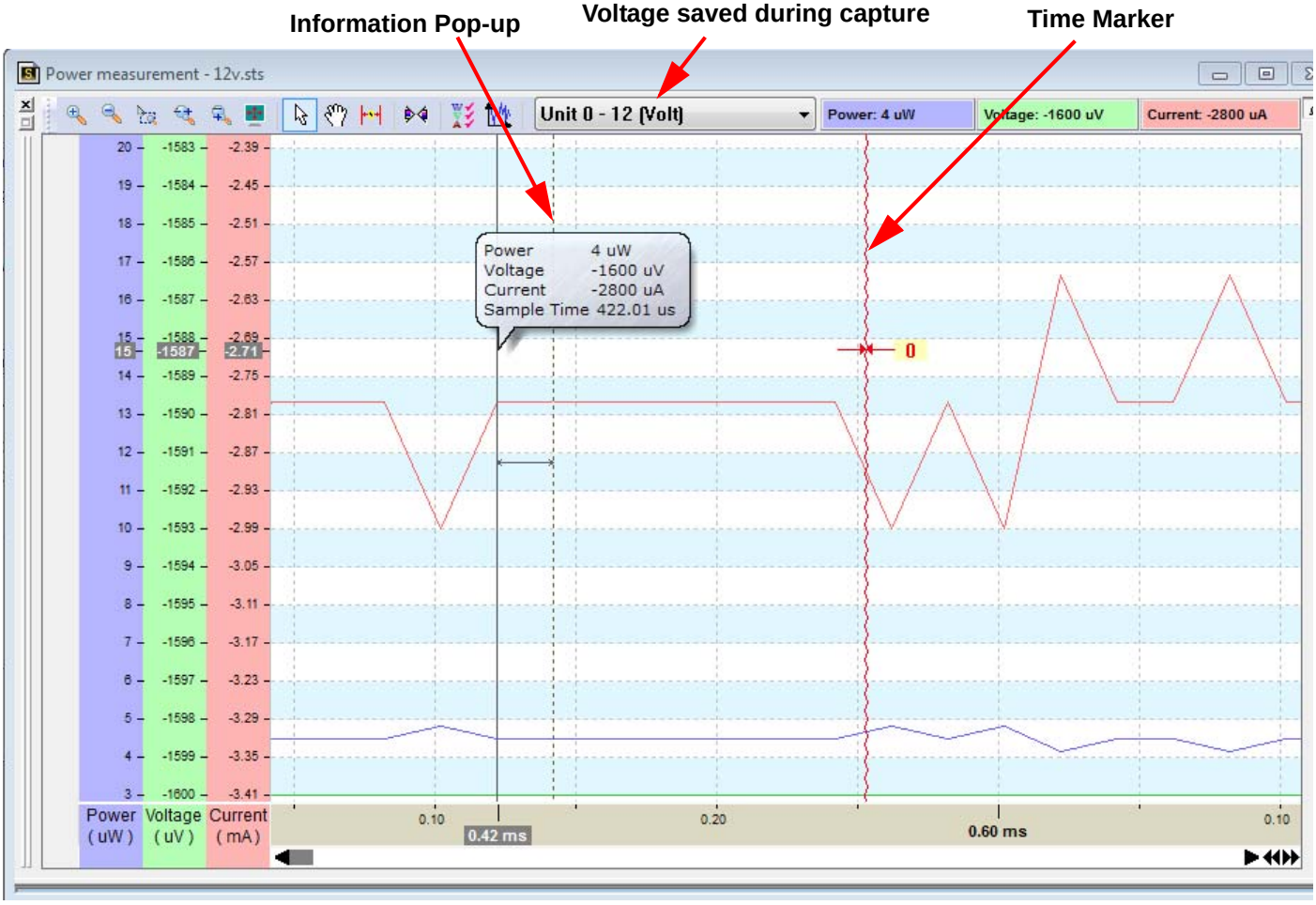
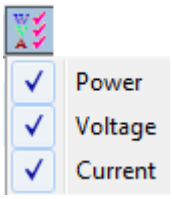
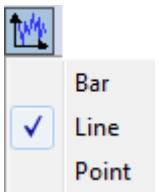


Figure 3.73: SATA: Power Tracker View

	The **Zoom In** button on the toolbar magnifies the data display area on the screen.
	The **Zoom In** button on the toolbar magnifies the data display area on the screen.
	The **Zoom By Selection** button on the toolbar magnifies the user selected area in the view.

	The **Zoom By H Drag** button on the toolbar magnifies the area selected by horizontally dragging and selecting in the view.
	The **Zoom By V Drag** button on the toolbar magnifies the area selected by vertically dragging and selecting in the view.
	The **Full Screen** button on the toolbar Toggles between normal and full screen view.
	The **Pointer Mode** button on the toolbar changes the cursor to a pointer.
	The **Hand Panning** button on the toolbar changes the cursor to a hand for panning.
	The **Insert Time Marker** button on the toolbar enables inserting a time marker at selected spot in the view (see Figure 3.73 on page 247).
	The **Sync by Time** button on the toolbar toggles between synchronizing and un-synchronizing all the views by time.
	The **Show/Hide Power Tracker types: W, V, A** button on the toolbar allows the user to select the parameters to view from the drop-down list.
	The **Change Power Tracker graph type: W, V, A** button on the toolbar allows the user to select one of the three graph types to view from the drop-down list.
	Displays the voltage saved during trace capture. This is selected in the Power Management Setting dialog (see "Power Management Setting (SATA only)" on page 105).

3.4.4 SAS Verification (SAS)

SAS Verification consists of a set of selectable tests to verify compliance with the SAS specification.

Note: Speed Negotiation and all other SAS tests are documented in the *SAS Verification Test Descriptions*.pdf. file in the installed Documents directory.

To run a SAS Verification Test:

1. Select **Analysis** on the main toolbar and choose **SAS Verification** to open the SAS Verification dialog (see Figure 3.74 on page 249).

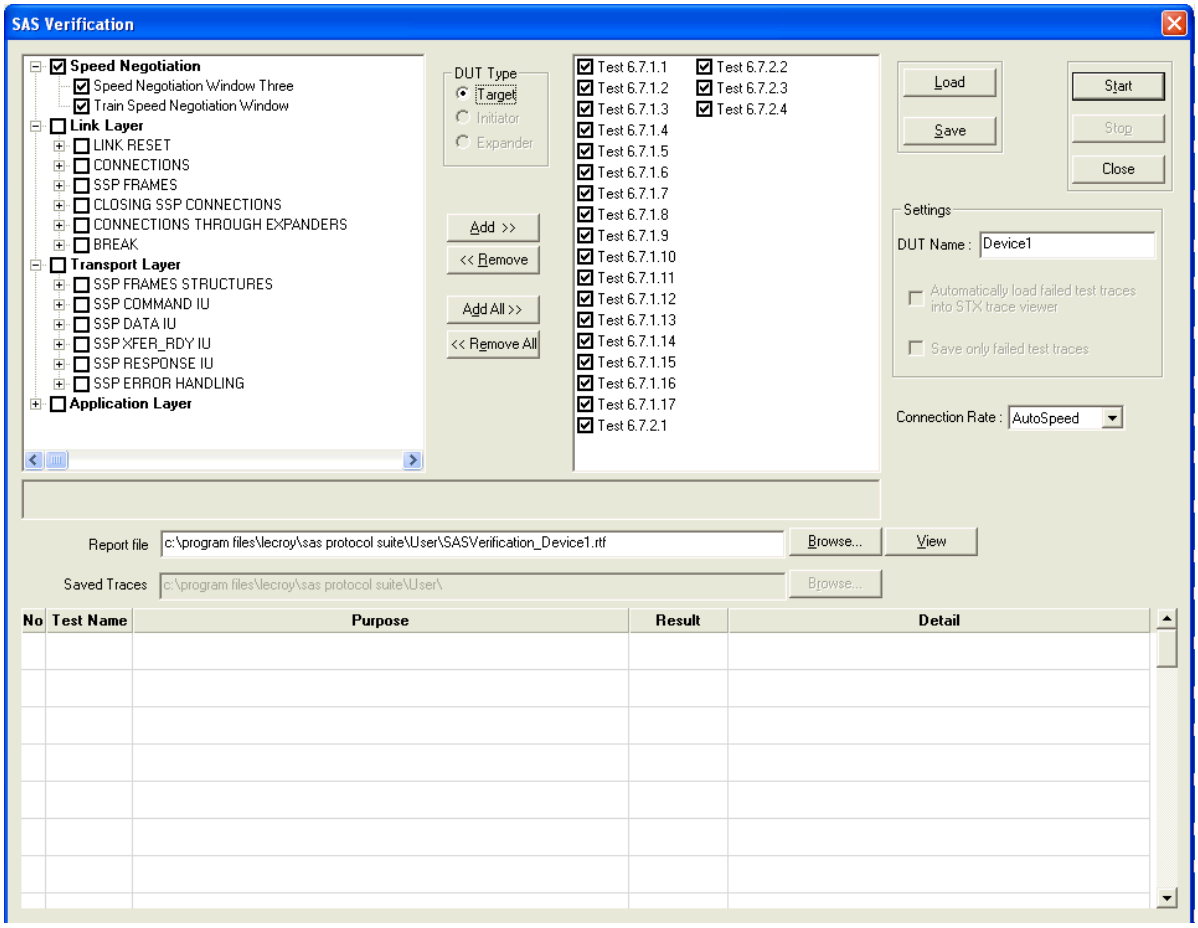


Figure 3.74: Run Verification Scripts Dialog

Speed Negotiation has Speed Negotiation Window Three and Train Speed Negotiation Window.

The Link Layer has Link Reset, Connections, SSP Frames, Closing SSP Connections, Connections through Expanders, and Break.

The Transport Layer has SSP Frames Structures, Command IU, Data IU, XFER_RDY IU, Response IU, and Error Handling.

The Application Layer has SCSI CDB, STP and NACA Operations.

2. Choose the tests in the left pane of the dialog and click the **Add>>** button.
3. Enter a value for **DUT Type**: Target, Initiator, or Expander.
4. Enter the **DUT Name**.
5. Enter the **Connection Rate** as Autospeed or a value.
6. To view failed test traces in the trace viewer, check the **Automatically load failed test traces into STX trace viewer** check box.
7. To save the failed test traces only, check the **Save only failed test traces** check box.
8. Enter a path and file name for **Report file**, or use the default file name and path: c:\program files\lecroy\sas protocol suite\User\SASVerification_Device1.rtf

9. Enter a path and file name for **Saved Traces**, or use the default folder: C:\Program Files\LeCroy\SAS Protocol Suite\User\
10. After you select tests, click **Start**.
11. The test runs and, after a brief period, displays the result.
12. To save the current compliance setup for later use, click the **Save** button to open the Save As dialog. Assign a meaningful name to the setup and save it as a ***.cst** compliance file.
13. To run a previously defined setup, click the **Load** button and choose a previously defined setup to run.

For the NACA test, both ports of the SAS device must be connected to two Host Emulation ports, I1 and I2, using two SATA cables.

Note: When you are running SAS Verification, you cannot work with Trainer and Emulator while device is connected to D connector and HBA is connected to H connector.

Note: You must use a Power Expansion Card (ACC-EXP-004-x or ACC-EXP-005-X) for the SATA Compliance Test. See "Using the Power Expansion Card" on page 30.

3.4.5 Compliance Test (SATA)

SATA Verification consists of a set of selectable tests to verify compliance with the SATA specification.

Note: The Digital Tests and the Phy Tests are documented in the *SATA_Digital-Device_MOI_LeCroy_1.00_UTD1.4.pdf* file in the installed Documents directory.

To run a SATA Compliance Test:

1. Select **Analysis** on the main toolbar and choose **Compliance Test** to open the SATA Compliance Test dialog (see Figure 3.75 on page 251).

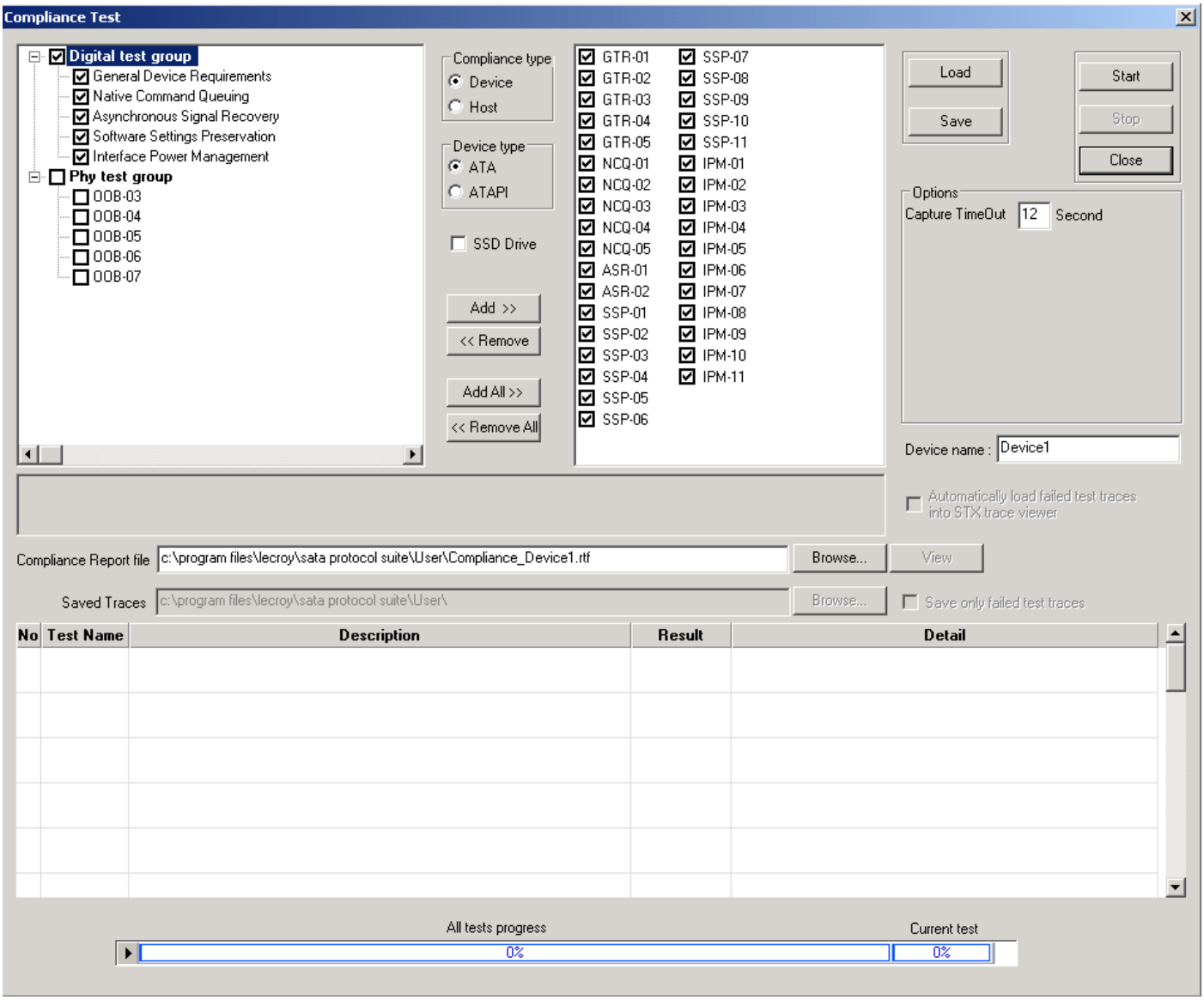


Figure 3.75: Compliance Test Dialog

The Phy Test and Digital Test groups are displayed in the left column. The Digital Tests comprise of the following:

- General Device Requirements
- Native Command Queuing
- Asynchronous Signal Recovery
- Software Settings Preservation
- Interface Power Management

2. Choose the tests in the left pane of the dialog by clicking on the checkboxes and click the **Add>>** button.

   You can add all or remove all by clicking **Add All** or **Remove All**.

3. Select a Compliance Type: Device or Host

4. Select a Device Type: ATA or ATAPI
5. Enter the **Capture Timeout** value in seconds**.**
6. To view failed test traces in the sample viewer, check the **Automatically load failed test traces into STX trace viewer** check box.
7. To save the failed test traces only, check the **Save only failed test traces** check box.
8. Enter a path and file name for **Report file**, or use the default file name and path: c:\program files\lecroy\sas protocol suite\User\Compliance_Device1.rtf
9. Enter a path and file name for **Saved Traces**, or use the default folder: c:\Program Files\LeCroy\SAS Protocol Suite\User\
10. After you select tests, click **Start**.
11. The test runs and, after a brief period, displays the result.
12. To save the current compliance setup for later use, click the **Save** button to open the Save As dialog. Assign a meaningful name to the setup and save it as a ***.cst** compliance file.
13. To run a previously defined setup, click the **Load** button and choose a previously defined setup to run.

Note: When you are running the Compliance Test, you cannot work with Trainer and Emulator while the device is connected to a D connector and HBA is connected to an H connector.

3.4.6 Running Verification Script Engine (VSE)

You can perform custom post-process analysis of the open trace by running a verification script over the trace. A verification script instructs the application to send trace and analysis information to the script. A verification script also contains script code, written using CATC Script Language (CSL) (see the **CSL_RefManual.pdf** document in the **docs** directory of the installation), used to process trace data and output that data in different formats.

Note: You may write your own verification scripts to perform custom verification and analysis. For information on how to write a verification script, see the *Verification Script Engine Reference Manual*.

To run a verification script over a trace:

1. Select the main menu item **Tools > Verification script** or click the **Running verification scripts** button on the main tool bar. The Run Verification Scripts dialog opens (see Figure 3.76 on page 253), from which you choose and then run one or several verification scripts:

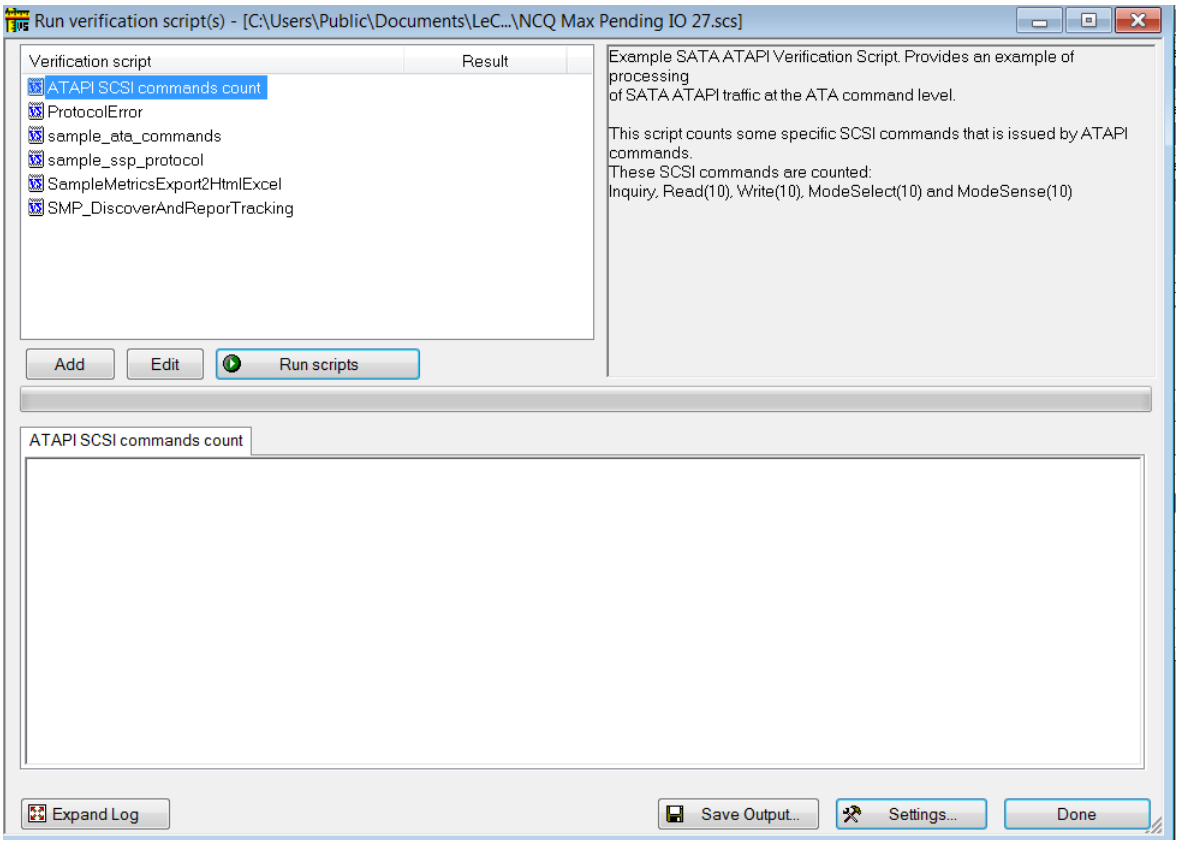


Figure 3.76: Run Verification Scripts Dialog

To expand the Log window, click the **Expand Log** button. The Log window fills the whole window. To see the Verification Scripts window again, click the Collapse Log button.

To save output, click the **Save Output** button.

2. After choosing **Settings** from the drop-down list or the button, the Settings dialog displays:

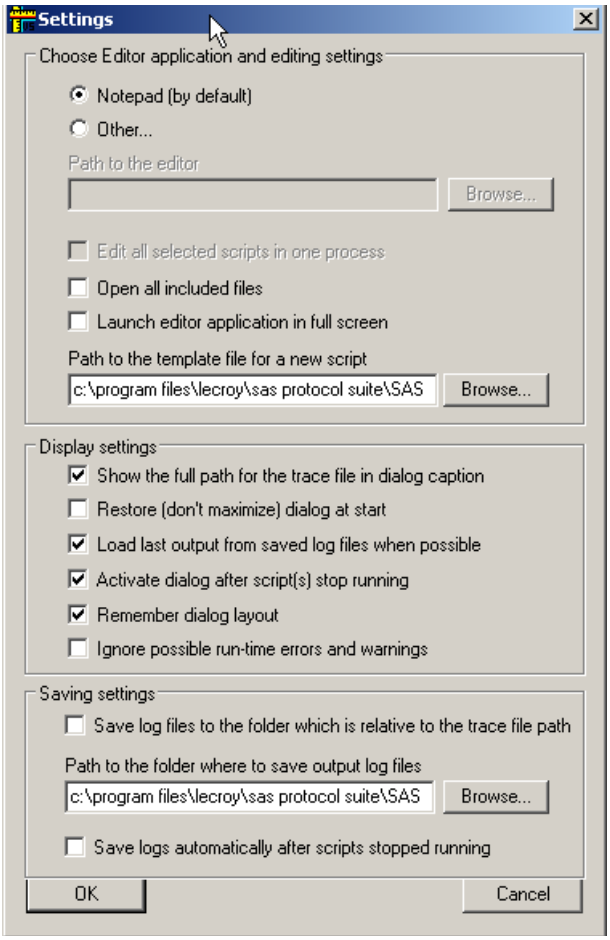

Settings
Choose Editor application and editing settings
Notepad (by default)
Other...
Path to the editor
Browse...
Edit all selected scripts in one process
Open all included files
Launch editor application in full screen
Path to the template file for a new script
c:\program files\lecroy\sas protocol suite\SAS
Browse...
Display settings
Show the full path for the trace file in dialog caption
Restore (don't maximize) dialog at start
Load last output from saved log files when possible
Activate dialog after script(s) stop running
Remember dialog layout
Ignore possible run-time errors and warnings
Saving settings
Save log files to the folder which is relative to the trace file path
Path to the folder where to save output log files
c:\program files\lecroy\sas protocol suite\SAS
Browse...
Save logs automatically after scripts stopped running
OK
Cancel

Figure 3.77: Run Verification Scripts - Settings Dialog

Choose the editor application: Notepad or other.

Edit all selected scripts in one process: If the editor supports multiple documents, you can edit all scripts in the editor.

Open all included files: You can edit included files, as well as the main script.

Launch editor application in full screen: You can use whole screen.

Path to the template file for a new script: You can use a template for the script.

Display Settings can show full trace-file path, restore dialog at start, load last output from save log files, activate dialog after scripts have run, remember dialog layout, and ignore errors and warnings.

Saving Settings can save log files to relative file folder, indicate output-log-file path, and save logs automatically.

3. Click the **Run scripts** button after you select scripts to run. VSE starts running the selected verification scripts, shows script report information in the output windows, and presents the results of verifications in the script list:

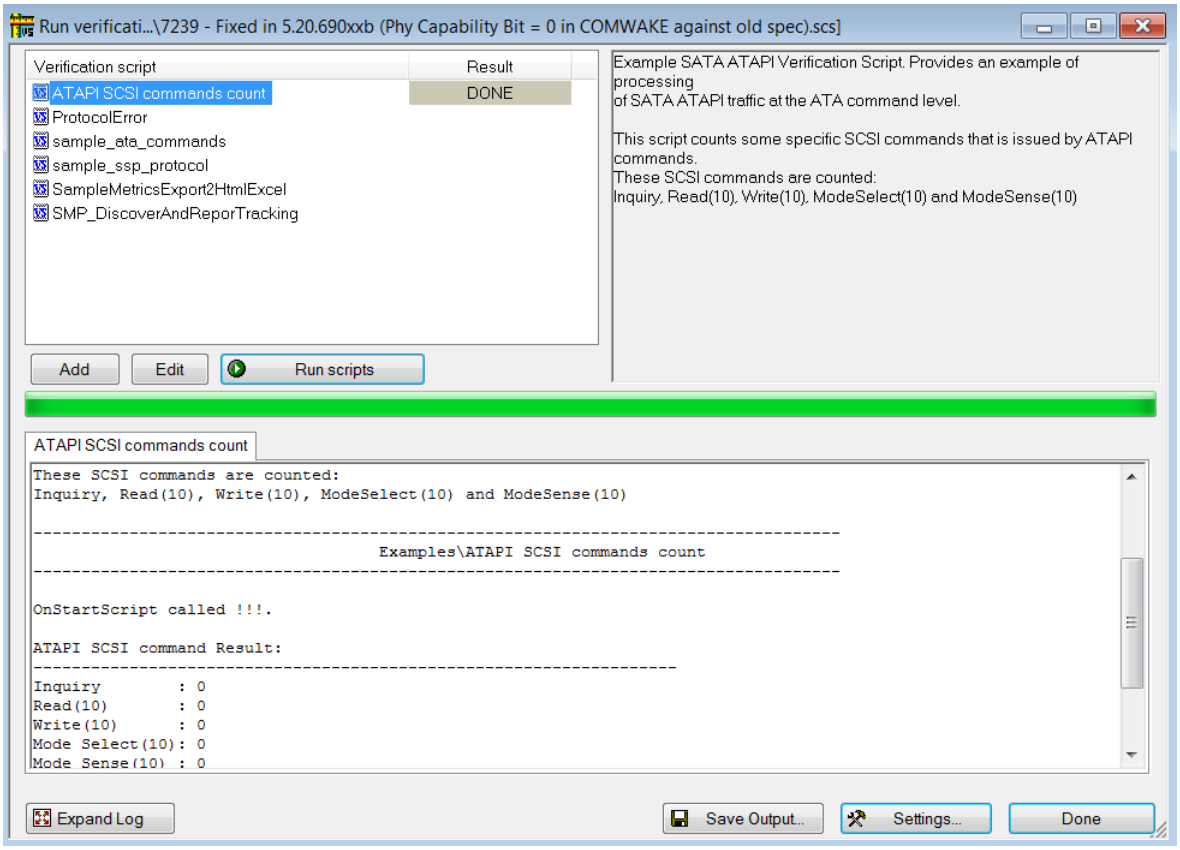


Figure 3.78: Run Verification Scripts Dialog

4. Right-clicking in the script list displays some additional operations over selected scripts:

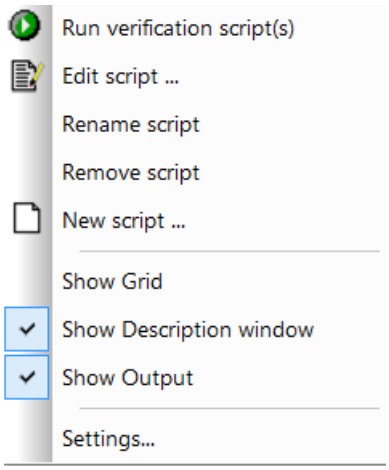


Figure 3.79: Run Verification Scripts - Menu

Run verification script(s): Start running selected script(s).

Edit script: Edit selected scripts in the editor application specified in Editor settings.

Rename script: Allows you to rename the selected script.

Remove script: Displays prompt for confirming removal of script.

New script: Create a new script file using the template specified in Editor settings.

Show Grid: Show/hide a grid in the verification script list.

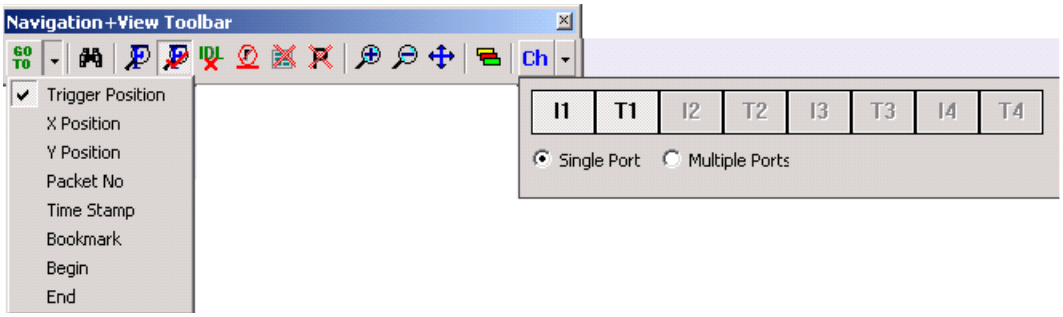
Show Description window: Show/hide the script description window (Shortcut key F2).

Show Output: Show/hide the script output windows (Shortcut key F3).

Settings: Open a special Setting dialog to specify different settings for VSE.

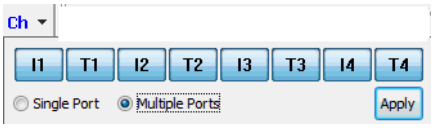
3.5 Navigation + View Toolbar

The Navigation + View toolbar allows you to navigate, search filter, hide RRDY/all primitives and unassociated traffic, zoom, tile views and select ports.



.

	The down arrow on the **Go To** button allows location of cursors or specific packets: Trigger Position, X Position, Y Position, Packet Number, Timestamp, Bookmark, Begin, and End.
	The **Search** button opens the search dialog (see “Search” on page 271).
	The **Filtering Setup** button opens the Filter dialog (see “Filtering” on page 261) and allows you to specify the criteria for filtering the result.
	The **Enable Disable Filtering** button toggles the result between a filtered and unfiltered view (see “Filtering” on page 261).
	The **Filter Idle** button toggles the display to show/hide idle packets (see “Filtering” on page 261).
	The **Hide RRDY Primitives** button toggles the display to show/hide RRDY primitives (see “Filtering” on page 261).
	The **Hide Unassociated Traffic** button toggles the display to show/hide unassociated traffic (see “Filtering” on page 261).

	The **Hide All Primitives** button toggles the display to show/hide all primitives (see “Filtering” on page 261. **Note:** When capturing PM traces, you need the ability to filter the PM primitives so you can find commands quicker.
	The **Zoom In** button on the Viewer Setting Toolbar magnifies the data display area on the screen. Clicking this button in Column or Text View increases column width only.
	The **Zoom Out** button on the Viewer Setting Toolbar scales the data display area to display more data lines on the screen. Clicking this button in Column or Text View decreases column width only.
	The **Normal Zoom** button on the Viewer Setting Toolbar resets the zoom to default normal on the screen. Clicking this button in Column or Text View resets column width only.
	You can use **Tile Horizontally All Views icon** or select **View > Tile Views** to revert any unintended window docking or sizing, or maximize screen utilization. This function only tiles views inside a trace window. Note that there is no command to tile views vertically.
	You can use this tool to incrementally Show or Hide Ports, either one at a time, or multiple ports at the same time. For multiple ports, select the desired ports to Show or Hide, and click **Apply** (see “Show/Hide Ports” on page 275).

3.5.1 Go To Menu

Locate Cursors

To quickly locate any cursor within the data viewer display, click the **Go To** button and choose the cursor to locate. You can also locate a cursor by selecting **Go To** from the Edit menu and choosing the cursor to locate.

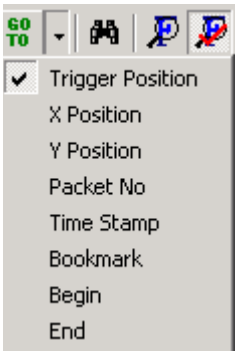


Figure 3.80: Locate Cursor

Go to Time Stamp

To locate a timestamp, click the **Go To** button and choose **Timestamp (see the following screen capture**.)

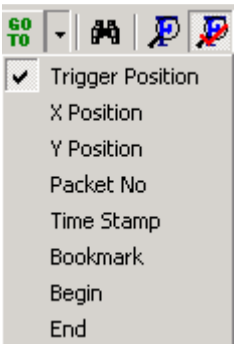


Figure 3.81: Time Stamp

Enter a time stamp value in the Go To Timestamp dialog and click **OK**.

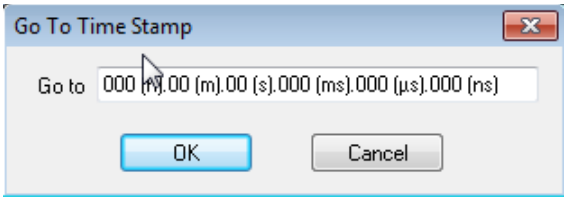


Figure 3.82: Go to Time Stamp

Bookmarks

Bookmarks are a convenient way to mark a point in the data viewer display by name, so that you can rapidly return to that point. To create a bookmark, right-click the mouse in the data viewer area on a packet in which to place the bookmark.

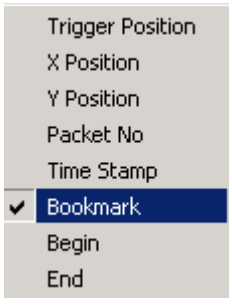


Figure 3.83: Bookmark

Click **Bookmark** from the fly out menu to open the Bookmark Comment Dialog.

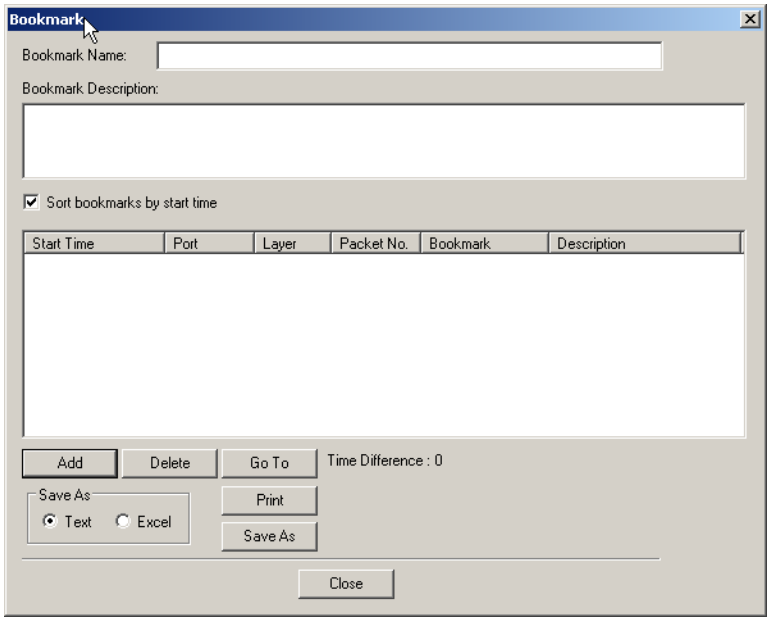


Figure 3.84: Bookmark Dialog

Enter a description for the bookmark and click the **Add** button. Repeat for additional **bookmarks.**

You can save the bookmark as a text file or Excel CSV file.

Note: Column View has a different bookmark mechanism than other views, and you can set a bookmark on each DWORD in the view. This makes Column View bookmarks unavailable in other views and vice versa.

Editing a Bookmark

If a packet has a bookmark, you can edit the bookmark by right-clicking the data viewer area of the packet, selecting the **Edit Bookmark** command from the pop-up menu, and changing the information in the Bookmark dialog (see above).

Finding a Bookmark

To find a bookmark in the data viewer display, right-click the mouse in the sample viewer and select **Bookmark** (see Figure 3.85 on page 260).

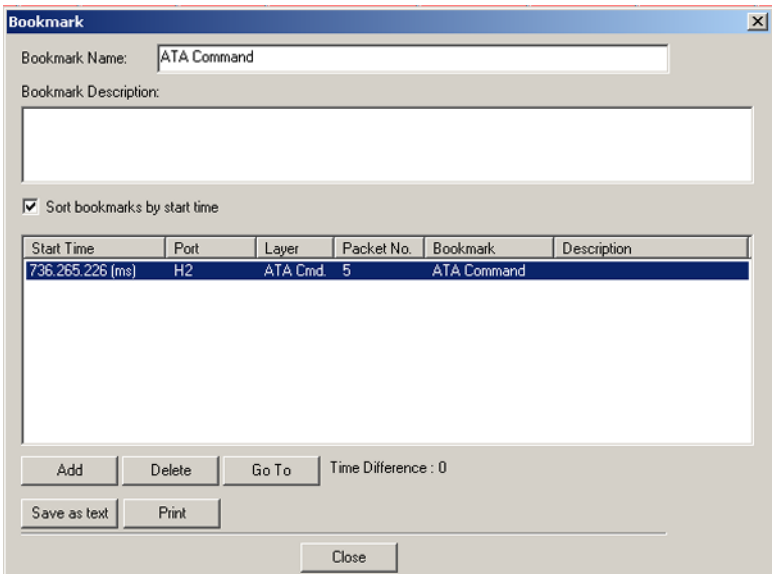


Figure 3.85: Go To Bookmark Dialog Box

Highlight the bookmark to which to go, then click the **Go To** button, or double-click the selection.

Figure 3.86: Bookmark Found Example in Data Viewer Display

Bookmark Description

To get a quick description of a displayed bookmark, position the tool tip over a bookmark. The name and description of the bookmark display.

Set Time Stamp Origin

Right-click in the sample viewer to open the fly out menu:

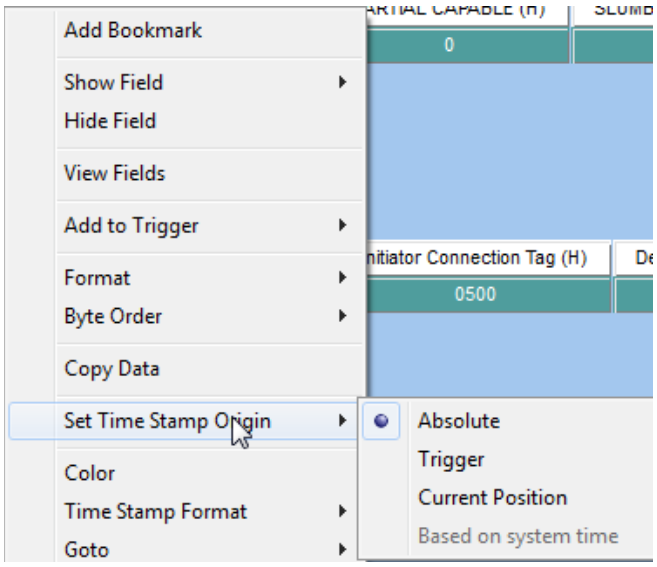


Figure 3.87: Bookmark Found Example in Data Viewer Display

Highlight **Set Time Stamp Origin** and choose either Absolute, Trigger, Current Position, or Based on system time.

3.5.2 Filtering

The Filtering menu and options allow you to modify data in the sample viewer display to exclude packets with a set of user-defined patterns and show the results in all views.

To set up filtering, you must have a viewer display open.

The Filtering menu has the options:

- Enable Filtering (see “Enable Filter” on page 270)
- Filtering (see “Filter Setup” on page 261)
- Link Layer (SAS)
- Transport Layer (SAS)
- Application Layer (SAS)
- Physical Layer (SATA)
- FIS Layer (SATA)
- Command Layer (SATA)
- Filter Idles (see “Filter Idle” on page 270)

3.5.3 Filter Setup

To display the Filter setup dialog, click the **Filter** button on the Viewer toolbar or select **View > Filtering** (see following screen capture**)**.

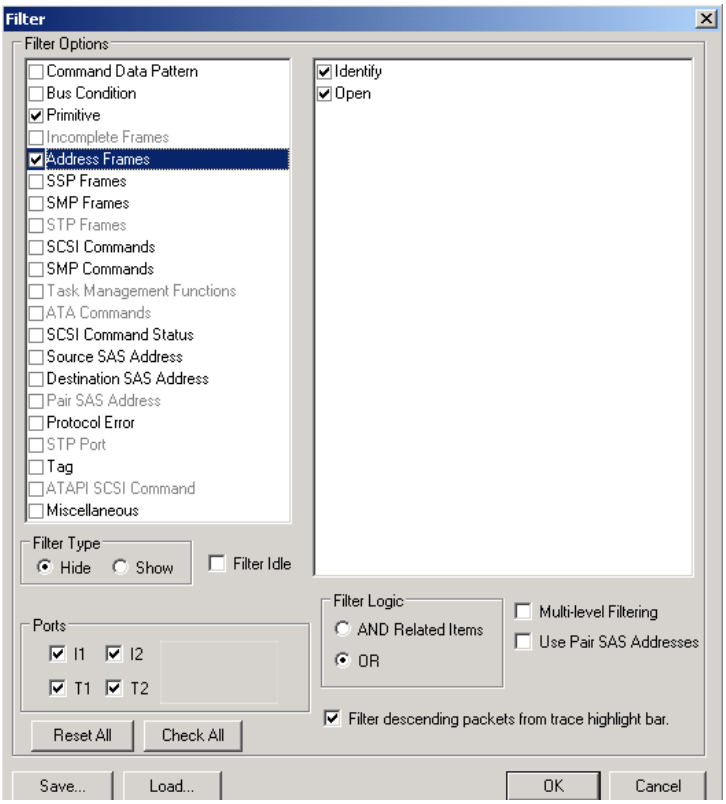


Figure 3.88: SAS: Filter Setup Dialog

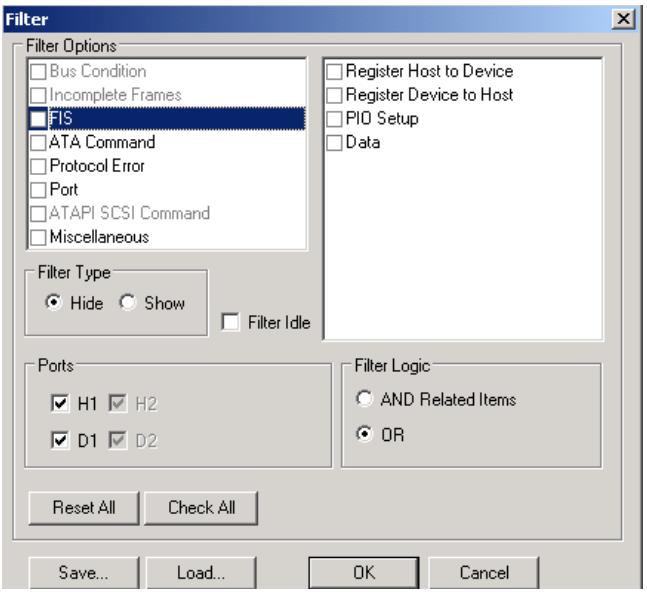


Figure 3.89: SATA: Filter Setup Dialog

You can select or deselect each of the items shown in the Filter Options window for filtering, by checking or unchecking a corresponding check box. Items not in the current sample are in shade.

Note: If you select a group, that also selects all child items.

Note: Only packets captured at run time are available for selection for filtering.

Filter Type

You can choose to show or hide the Filter Type items by checking the **Show** or **Hide** option button.

Note: When capturing PM traces, you need the ability to filter the PM primitives so you can find commands quicker.

Filtering Direction

You can select items for filtering in a single direction or both directions by checking the corresponding Port. By default, all ports are enabled. Uncheck the port check boxes for ports not to include in the filter.

Filter Idle

Depending on the Filter Type (Hide/Show), Idle packets in the Sample Viewer are shown or hidden.

Save Filter Setup

After you have set up a Filter configuration, you can save it as an SAS Filter file (***sfl**) or SATA Filter file (***.tfl**) by clicking **Save**. You can then use it on a different capture by clicking **Load** in the Filter dialog.

Filter Logic

After you have set up Filter options, you can set filter logic to **And Related Items** to apply "AND" logic on related selected options (for example, SCSI commands and SAS Addresses) or **OR** to apply "OR" logic on all selected options.

Multilevel Filtering in SAS

You can set up a filter in a sequential steps by **Multi level filtering**. In each level, you can select specific items to "AND" to the previous level. The results of all levels show in views (see following screen captures).

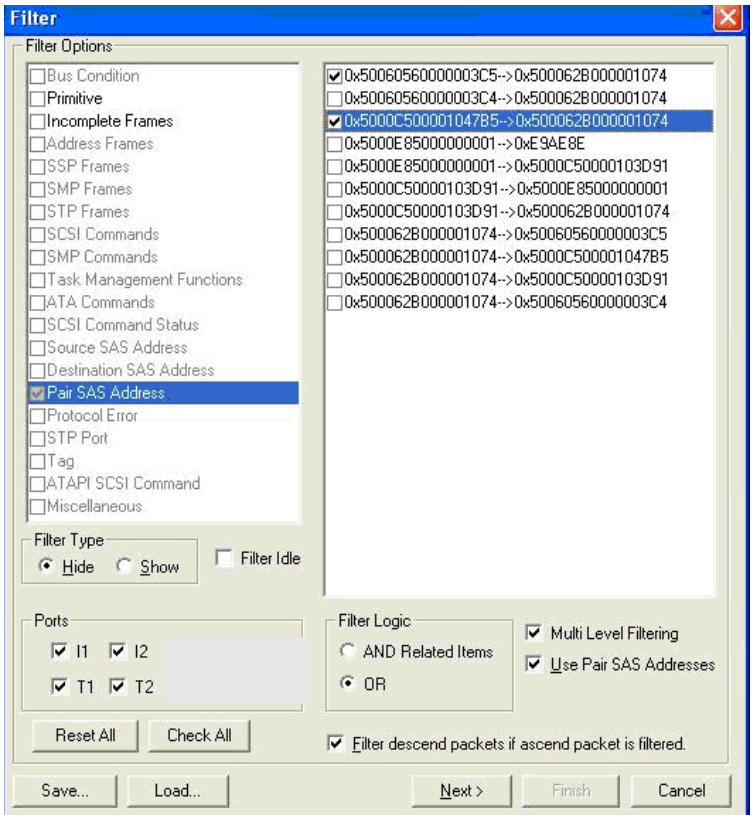


Figure 3.90: First Level of Multilevel Filtering

.

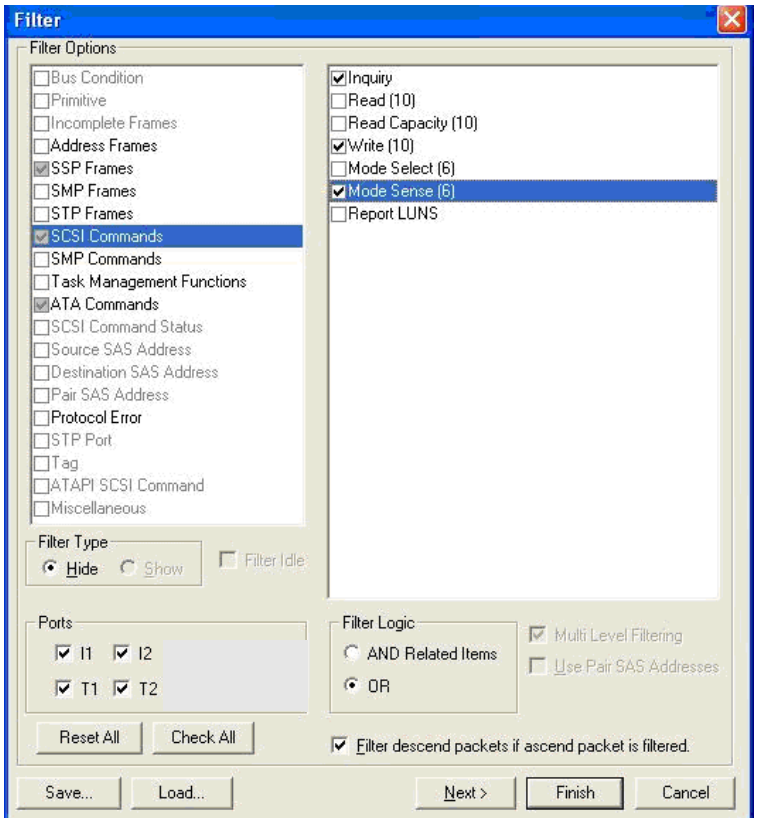


Figure 3.91: Second Level of Multilevel Filtering

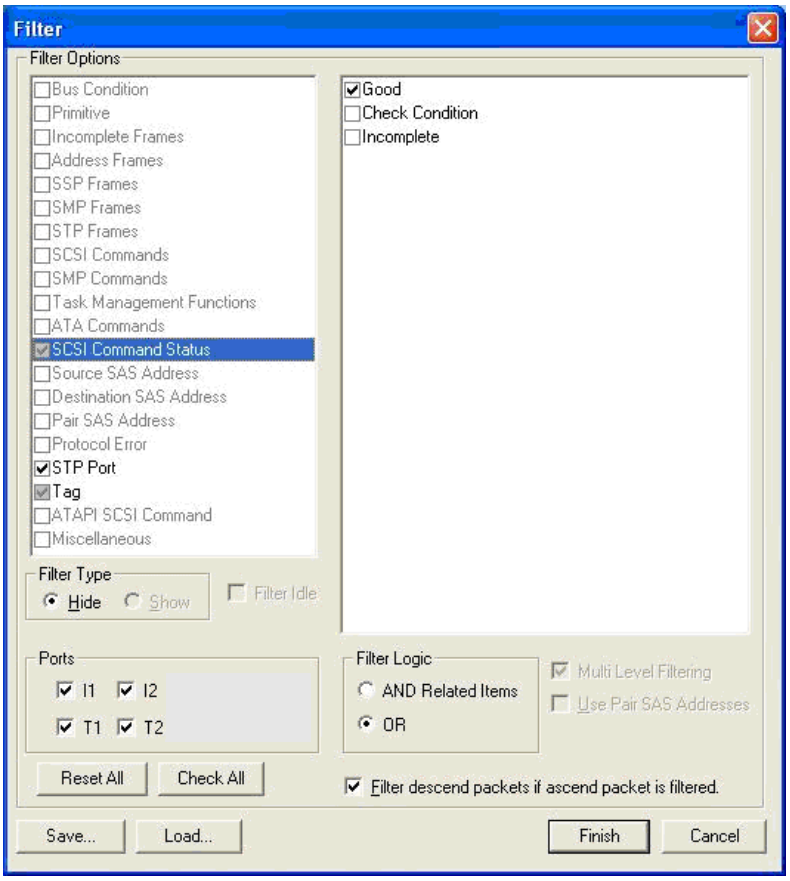


Figure 3.92: Third Level of Multilevel Filtering

Filter descending packets from trace highlight bar

If you check the **Filter descend packets if ascend packet is filtered** checkbox, the application will only filter onward from the highlighted trace selection bar.

If you uncheck this option, the software only filters the filtered packet. For example, if this option is checked and any SCSI command is selected, all transport and link packets of this command are filtered. If you unchecked this option, only selected SCSI commands are filtered.

3.5.4 Selectable Filter Options for SAS

The SAS Filter Options are:

- Command Data Pattern
- Bus Condition
- Primitive
- Incomplete Frames
- Address Frames
- SSP Frames
- SMP Frames
- STP Frames
- SCSI Commands

- ❑ SMP Commands
- ❑ Task Management Functions
- ❑ ATA Commands
- ❑ SCSI Command Status (see “Filter Check Condition” on page 266).
- ❑ Source SAS Address
- ❑ Destination SAS Address
- ❑ Pair SAS Address
- ❑ Protocol Error
- ❑ STP Port
- ❑ Tag (see “Filter by Tag Number” on page 267).
- ❑ ATAPI SCSI Command
- ❑ Miscellaneous (see “Filter Miscellaneous” on page 268).
- ❑ Training Sequence

Command Data Pattern

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Command Data Patterns in the Sample Viewer.

Bus Condition

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Bus Conditions in the Sample Viewer.

Incomplete Frames

When selected, depending on the Filter Type, the Hide/Show selection shows or hides Incomplete Frames in the Sample Viewer.

ATA Command

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured ATA commands in the Sample Viewer.

Protocol Error

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured packets with the specified Protocol Errors in the Sample Viewer.

ATAPI SCSI Command

When selected, depending on the Filter Type, the Show/Hide selection shows or hides ATAPI SCSI commands.

Filter Check Condition

Checking the **SCSI Command Status** check box enables Check Condition for filtering (see Figure 3.93 on page 267).

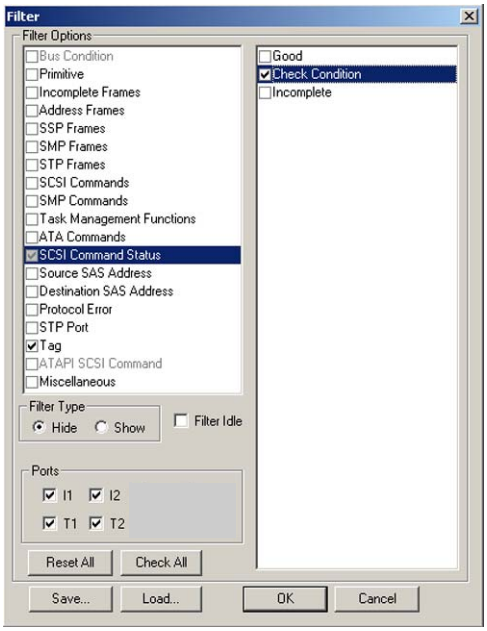


Figure 3.93: SAS: Filter Check Condition

Filter by Tag Number

Checking the **Tag** check box displays tags available for filtering. Check the corresponding check boxes for tags to filter.

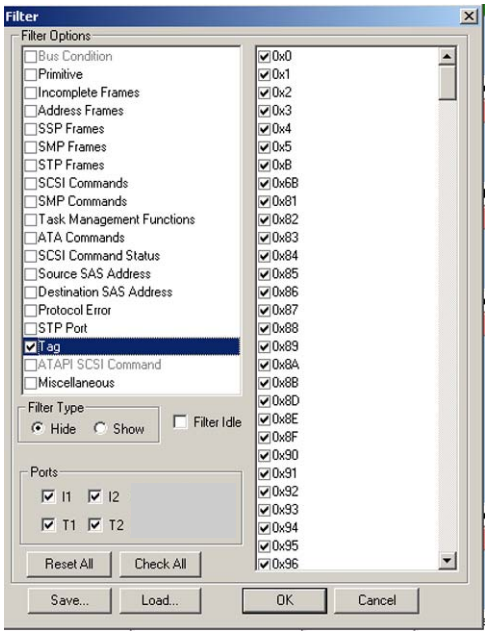


Figure 3.94: SAS: Filter by Tag Number

Filter Miscellaneous

When you choose **Miscellaneous**, an additional dialog displays, allowing you to specify the filtering of State Range and/or External Signal In.

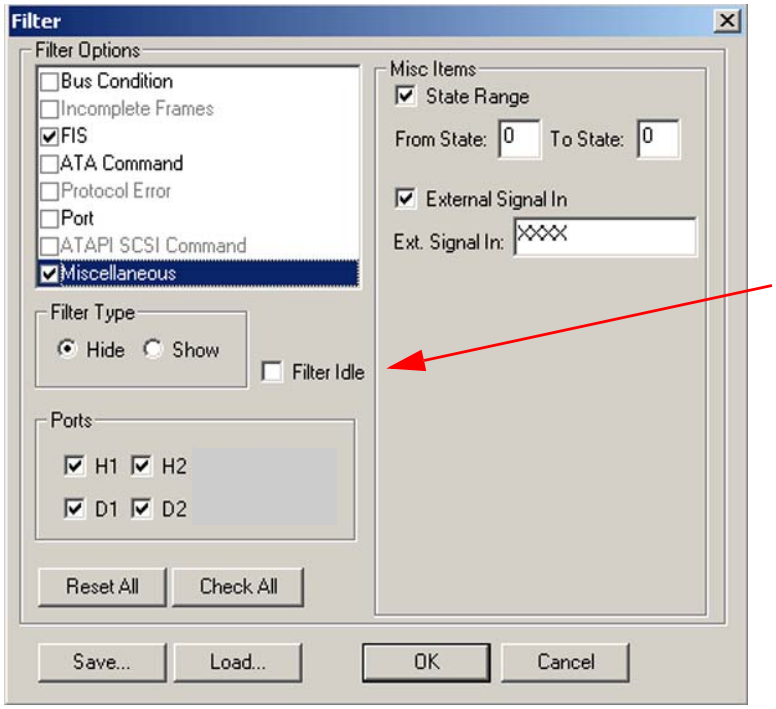


Figure 3.95: Filter State and/or External Signals

Use Pair SAS Addresses

You can use all available pair SAS addresses (Source -> Destination) instead of using SAS source and destination addresses. To enable the pair SAS address filter option, check **Use Pair SAS Addresses** check box in the Filter dialog.

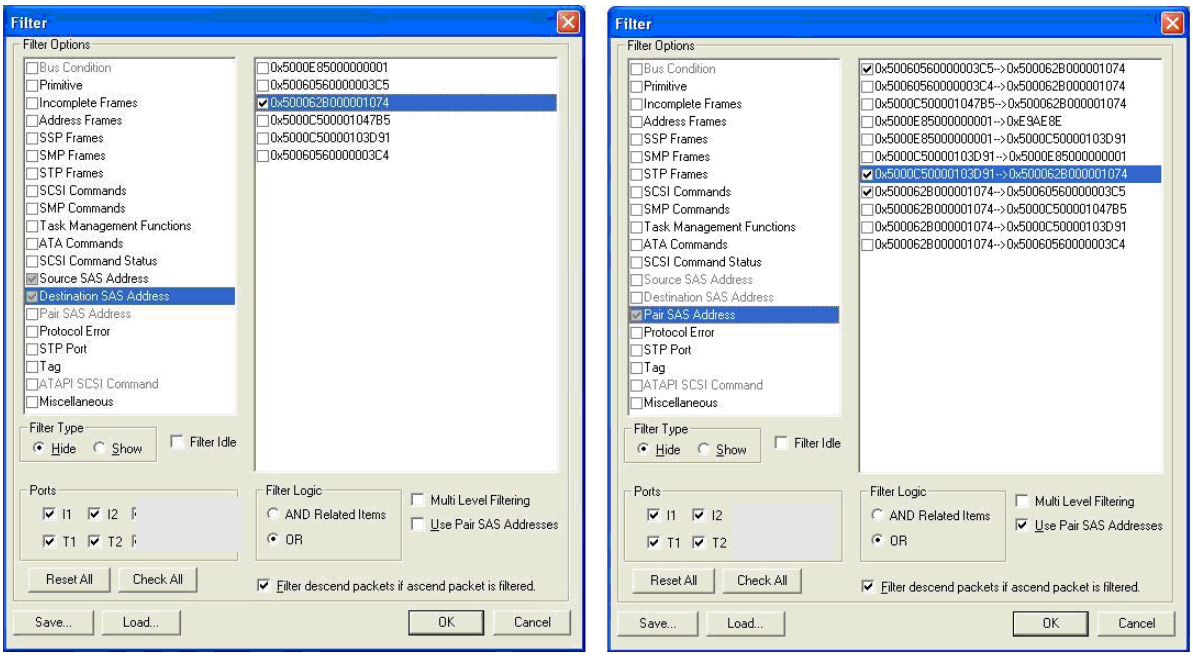


Figure 3.96: SAS: SAS Address Filtering before and after Using Pair SAS Addresses

Note: If you enable pair SAS addresses, the source/destination SAS addresses options are disabled and filtering on them is ignored at filtering time. If you disable pair SAS addresses, the pair SAS address option is disabled and filtering on it is ignored at filtering time.

Training Sequence

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Training Sequences in the Sample Viewer.

3.5.5 Selectable Filter Options for SATA

The SATA filter options are:

- Bus Condition
- Incomplete Frames
- FIS
- ATA Command
- Protocol Error
- Port
- ATAPI SCSI Command
- Miscellaneous
- Filter Idle (see Figure 3.95 on page 268)

Bus Condition

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Bus Conditions in the Sample Viewer.

Incomplete Frames

When selected, depending on the Filter Type, the Hide/Show selection shows or hides Incomplete Frames in the Sample Viewer.

FIS

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured FIS items in the Sample Viewer.

ATA Command

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured ATA commands in the Sample Viewer.

Protocol Error

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured packets with the specified Protocol Errors in the Sample Viewer.

Port

When selected, depending on the Filter Type, the Show/Hide selection shows or hides packet traffic for the selected port.

ATAPI SCSI Command

When selected, depending on the Filter Type, the Show/Hide selection shows or hides ATAPI SCSI commands.

Miscellaneous

When you choose Miscellaneous, an additional dialog displays, allowing you to specify the filtering of State Range and/or External Signal In (see “Filter Miscellaneous” on page 268).

3.5.6 Enable Filter

Select **Filtering > Enable Filtering** or click the **Filter Enable** button on the display menu bar to toggle between Filtered and Unfiltered display.

3.5.7 Filter Idle

Depending on the Filter Type (Hide/Show), Idle packets in the Trace Viewer are shown or hidden.

You can quickly filter idles by clicking the

Filter Idle button. This button toggles between Show and Hide items.

3.5.8 Search

The Search menu and toolbar options permit you to examine any data capture file to quickly locate the packet or data pattern.

To perform an initial search, select **Edit > Search** or click the **Search** button to open the Search setup dialog (Figure 3.97).

Note: Only items captured in the sample file are enabled for search.

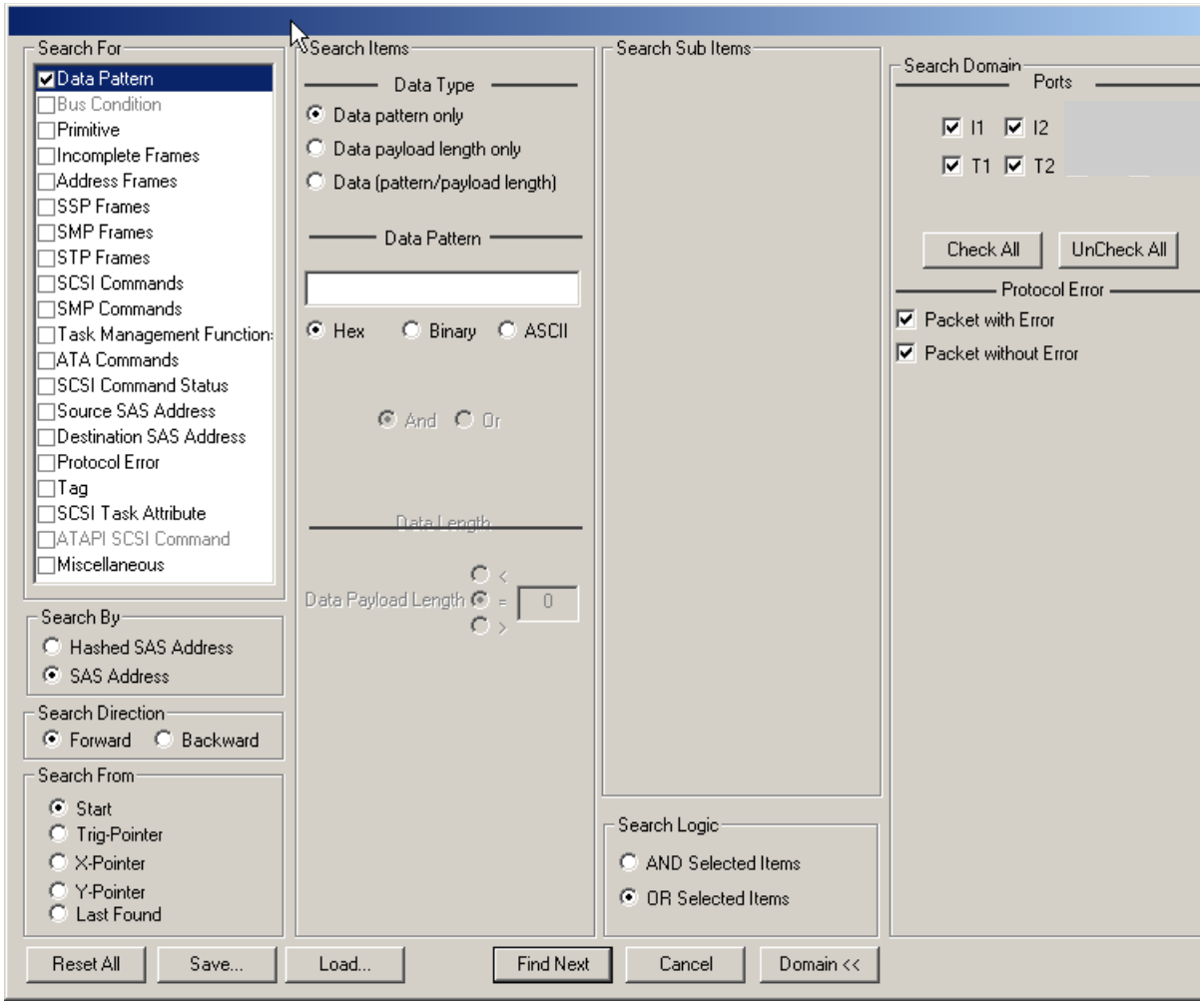


Figure 3.97: SAS: Search Data Pattern

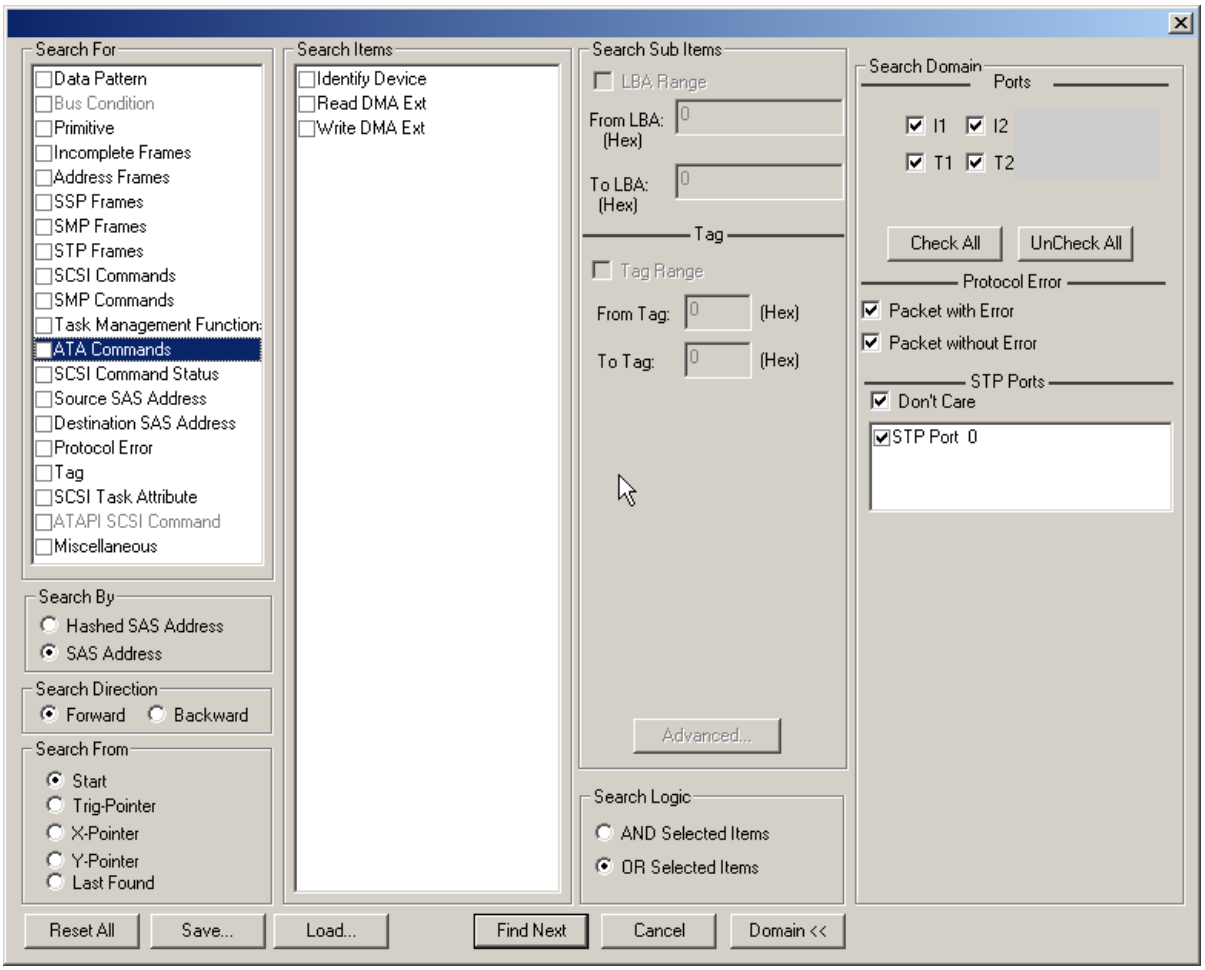


Figure 3.98: Search Parameter Definition Dialog

You can continue to search the output file using **Next Search (F3)** or **Previous Search (F4)** for the same pattern, until you redefine the data capture search parameters.

Save Search Setup

After you have set up a Search configuration, you can save it as a SAS Search configuration file (***.ssh**) or a SATA Search configuration file (***.tsh**) by clicking **Save**. You can then use it on a different capture by clicking **Load** in the Search dialog.

Search By

Choose **Hashed SAS Address** to search on hash address, or choose **SAS Address** to search for address.

Search Direction

Choose either **Forward** or **Backward** direction in which to perform the search.

Search From

Choose a starting point to begin or continue a search: Start of the sample file, Trigger Pointer, X Pointer, Y Pointer, or Last Found.

Search Logic

The default setting is **Or Selected Items**. With this setting, clicking **Find Next** locates all selected items in turn. If you choose **And Selected Items,** you can set a logical AND combination of items to find. Both options allow setting Advanced search features.

Search For

Choose a category to search in the **Search For** window. Each of the search categories offers additional choices in the **Search Items window** to refine the search. Check items for the selected category.

Data Pattern

Search for Data Pattern allows you to search for a specific Data Type, Pattern, and Length (see Figure 3.97).

- Data Pattern Only
- Data Payload Length Only
- Data Pattern and Data Payload Length

Advanced options

Some of the Search For categories offer advanced options for search. To set these options, highlight the search item in a category and click the **Advanced** button to open the Advanced options dialog.

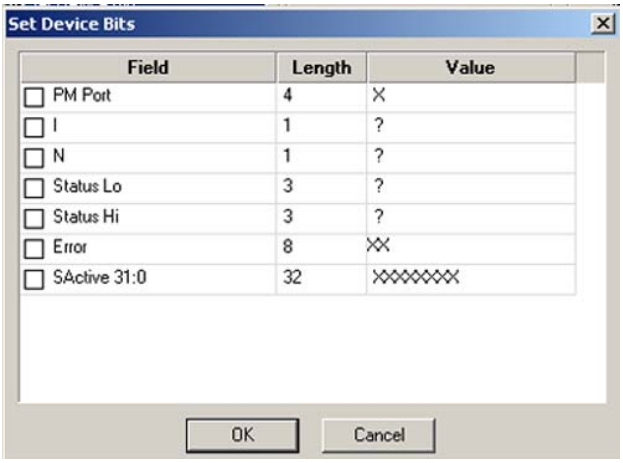


Figure 3.99: Advanced Options Dialog Example: Set Device Bits

Set the options and click **OK.**

Search Domain

Click the **Domain** button and choose a search domain from all ports or a specific port.

Protocol Error

You can refine the search to locate packets with an error or without an error.

Note: When searching for Protocol Errors in Column View, you cannot search for a specific Protocol Error type. Search returns any protocol error.

Search Sub Items

When searching SCSI Command Status, you can refine the search by selecting from a list of Sub Items.

Note: Some of the search categories allow you to refine the search by specifying specific SAS addresses and STP ports to search.

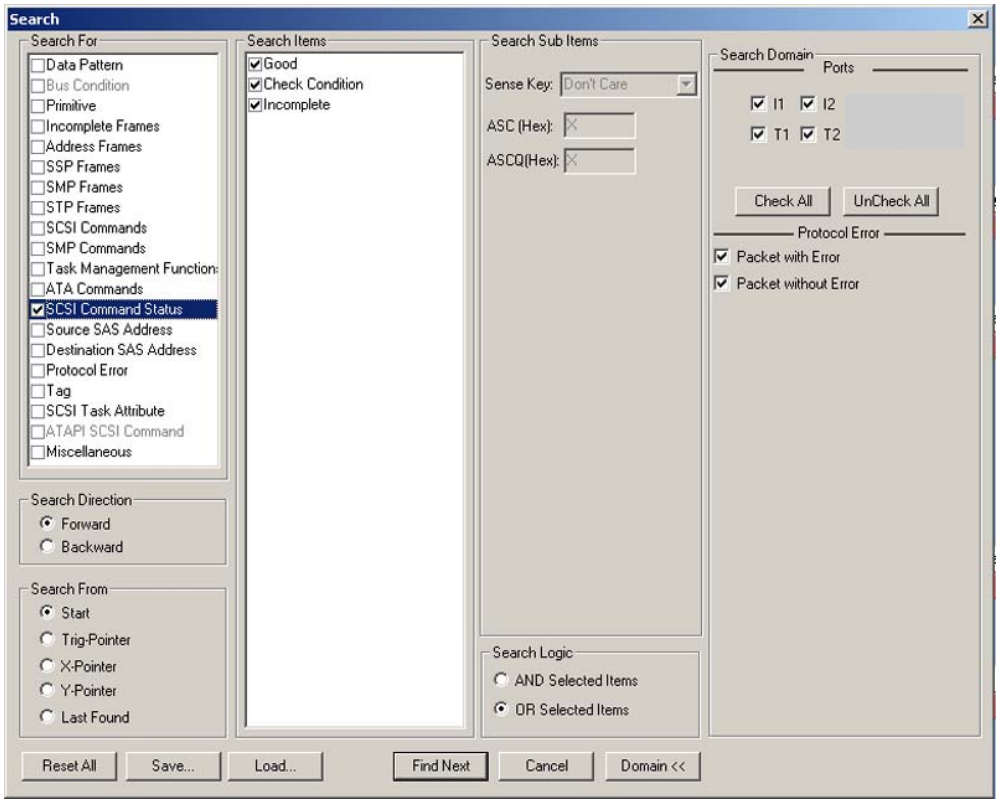


Figure 3.100: Search Sub Items

When you check the **SCSI Command Status,** the **Check Condition** item appears in the Search Items Window, if a check condition has occurred. Clicking this enables **Search Sub Items,** allowing you to refine the search by specifying **Sense Key, ASC,** and **ASCQ.**

Search by Tag Number

To search by Tag Number, check the **Tags** box in the Search For window and then check the Tag(s) for which to search in the Search Items window.

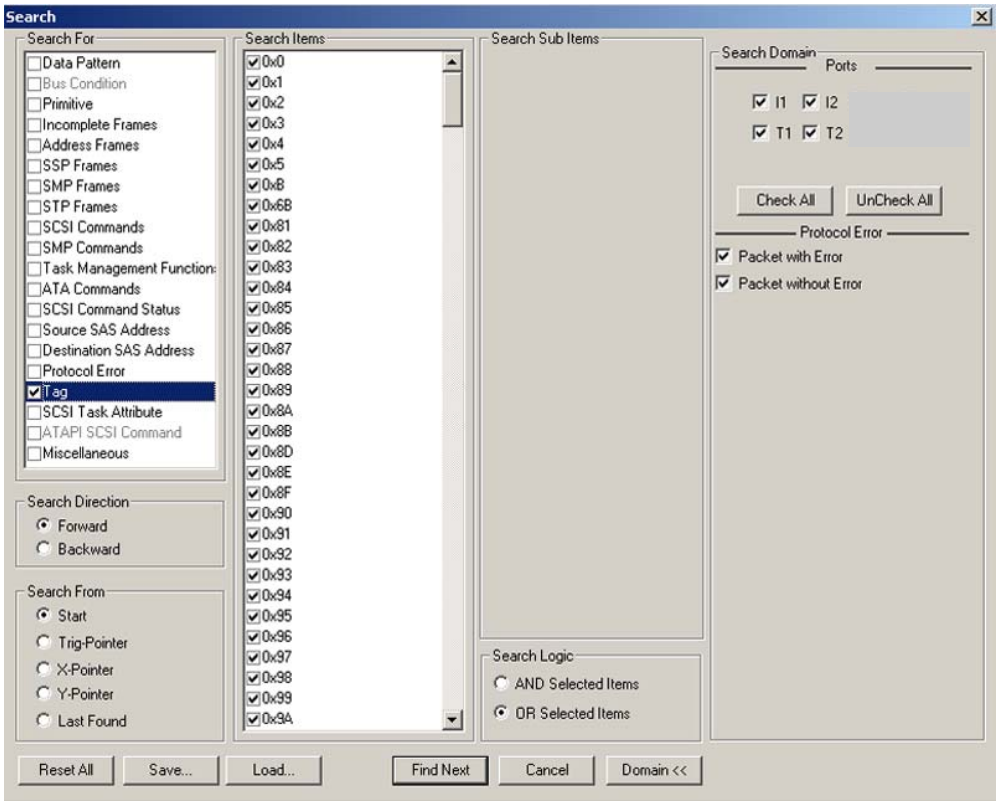


Figure 3.101: Search by Tag Number

3.5.9 Show/Hide Ports

You can **Show/Hide a Single Port** or you can **Show/Hide Multiple Ports**. To do so click on the **Ch Down Arrow.**

Single Port

If Single Port is selected, you can click on one port button at a time to show/hide the capture for that port. Show/Hide Single Port is time consuming as it shows or hides one port at a time.

Multiple Ports

If Multiple Ports is selected, you can click on multiple ports to show or hide them. This mode is much faster. Click on multiple ports to show or hide them.

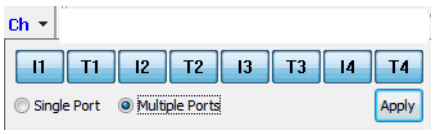


Figure 3.102: SAS: Show/Hide Ports Toolbar

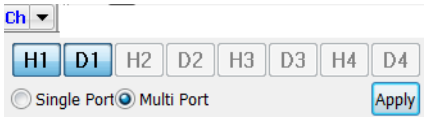
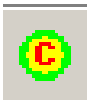
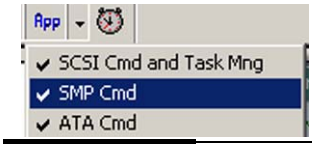


Figure 3.103: SATA: Show/Hide Ports Toolbar

You can also show or hide a port by right-clicking a **Port ID** in Text View or Column View and choosing **Show** or **Hide** (see Figure 3.107 on page 280).

3.6 Packet View Toolbar

The Packet View toolbar allows wrapping, zooming, and configuration.

	The **Wrap Packets** button on the Viewer Toolbar wraps the packet data in the display to eliminate the need for horizontal scrolling.
	Go to CATC Navigation View. Click this button to change the trace display to a CATC Trace™. You can change the colors, fonts, and so on, in the Trace Viewer Configuration (see “Trace Viewer Configuration” on page 288).
	The **Show/Hide Link Packet** button displays/hides the Link layer (SAS only).
	The **Show/Hide Transport Packet** button on the Layers Toolbar displays/hides the Transport layer and below (SAS only).
	The **Show/Hide All Commands Packet** button shows/hides the Command layer and all layers below: SCSI Cmd and Task Mng, SMP Cmd, and ATA Cmd (SAS only).  Click the down arrow on the Show/Hide All Commands Packet button to choose command types to show/hide.
	The **Show/Hide Physical Packet** button toggles the display of physical layer packets (SATA only).

	The **Show/Hide FIS packet** button toggles the display of FIS layer packets. When “OFF”, the FIS layer and its links are hidden (SATA only).
	The **Show/Hide CMD packet** button toggles the display of the CMD packets. When “ON”, only the command layer displays (SATA only).
	The **Show/Hide Command Queue** button displays queued commands. SATA only.
	The **Order/Reorder** toggles the time order of packets. SATA only.
	The **Pack/Unpack Repeated Primitives** toggles packing repeated primitives in one port. SAS only.
	The **10B** button displays the payload data as 10-bit encoded data.
	The **8B** button displays the payload as 8-bit scrambled or unscrambled data, depending on the Scrambled setting.
	The **SC** button selects scramble/unscramble for the 8-bit payload data.
	The **PV** button shows/hides the primitive value.

3.6.1 CATC Navigation View

To change the trace display to a CATC Trace™ (see Figure 3.104 on page 278), click the CATC Navigation button. You can change the colors, fonts, and so on, in the Trace Viewer Configuration (see “Trace Viewer Configuration” on page 288).

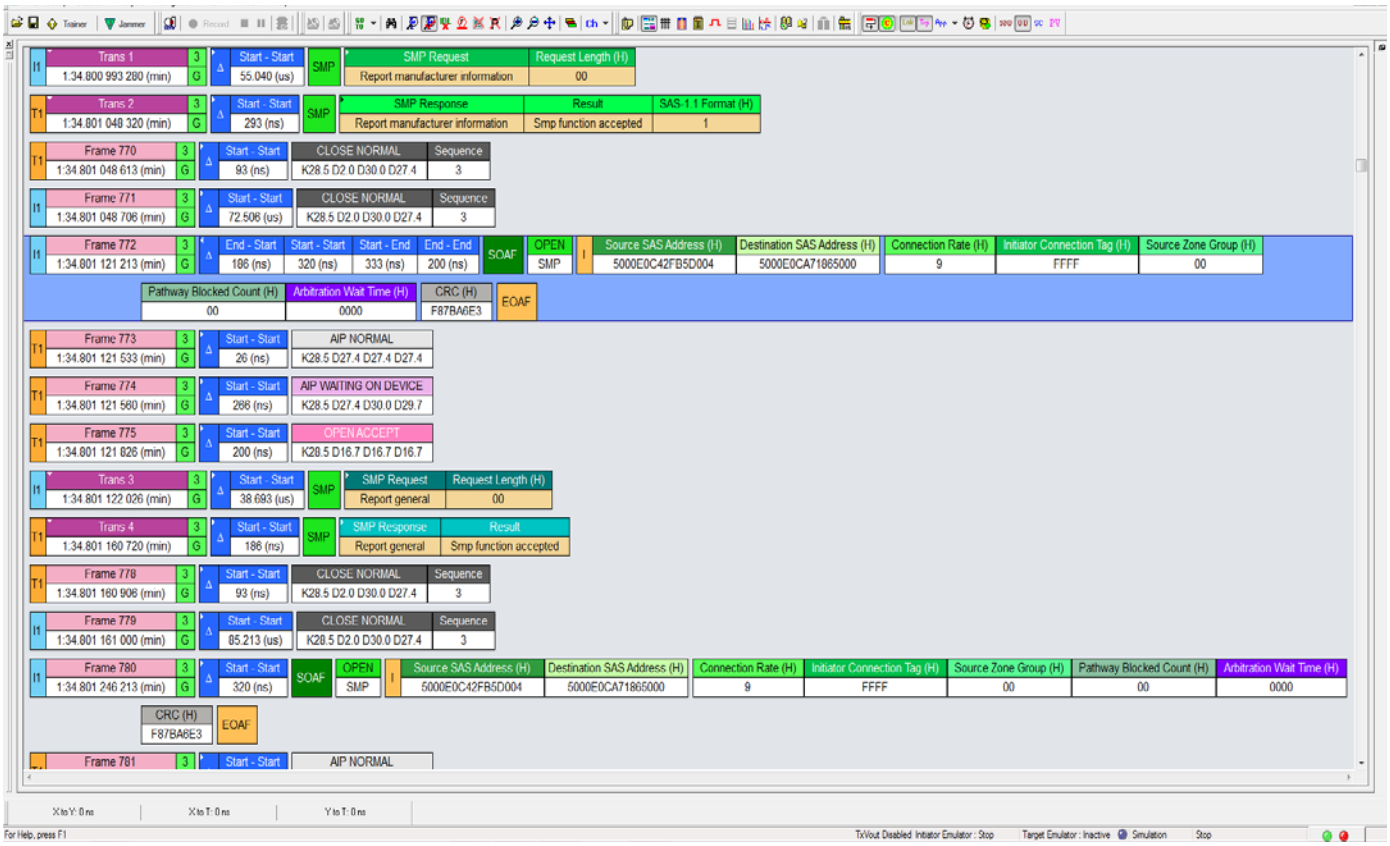


Figure 3.104: CATC Navigation View

3.6.2 Spec View

Spec View shows packet header information.

To obtain the Spec View from the CATC View, left-click to display a popup menu, then select the **View Fields** option (see Figure 3.105 on page 279.)

To obtain the Spec View from the Catalyst View, right-click to display a popup menu, then select the **View Fields** option.

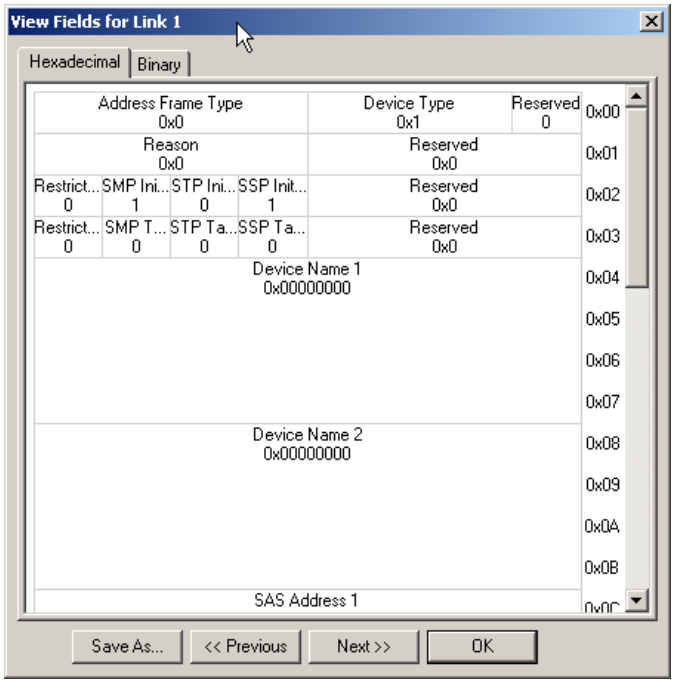


Figure 3.105: Spec View

The tabs allows you to display **Hexadecimal** or **Binary**.

The buttons allow you to go to **Previous** or **Next**.

You can **Save As** a text file.

3.6.3 Decode Icons

The **Decode Toolbar** controls encoding and scrambling features.

To view corresponding Unscrambled and Scrambled payload data values instantaneously, position the mouse pointer over a data field.

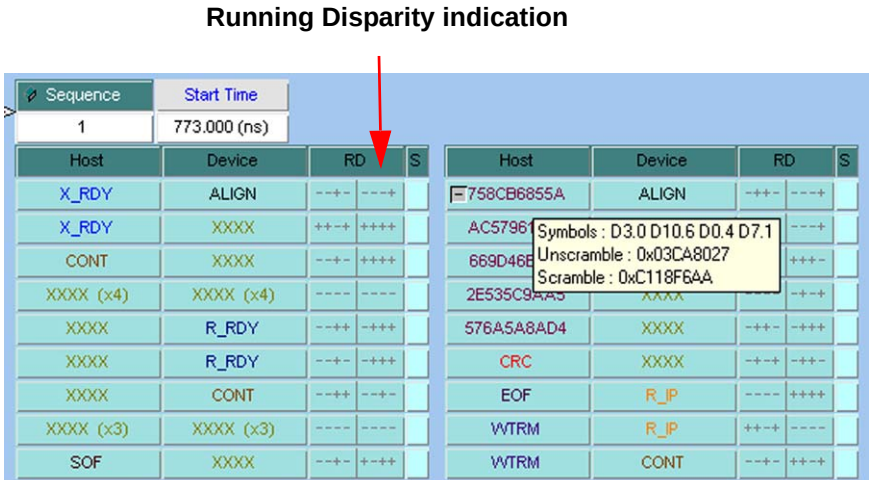


Figure 3.106: Payload Data Display

3.6.4 Customize Display

Rename Port

You can rename each port for easy identification. To rename a port, right-click the **port ID** in Text View or Column View.

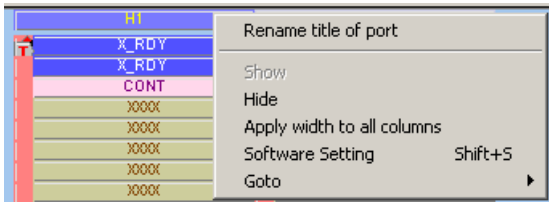


Figure 3.107: Rename Port

Choose **Rename title of port** to open the Rename Title of Port dialog.

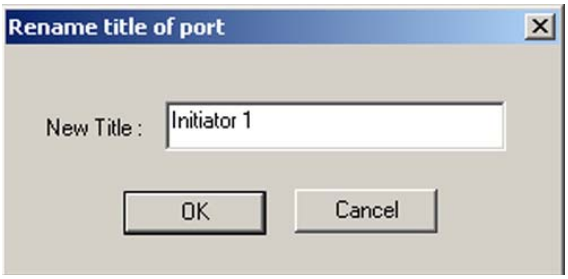


Figure 3.108: Rename Title of Port

Show/Hide Field

You can simplify the Viewer display by hiding some fields. You can hide the **Duration**, **Relative Time**, **External Signals,** and **Packet number** fields by right-clicking the corresponding field title and choosing **Hide Field** (see Figure 3.109 on page 280).

Figure 3.109: Hide Field

To restore a field to the display, right-click a **Port ID** field and choose the hidden field to restore.

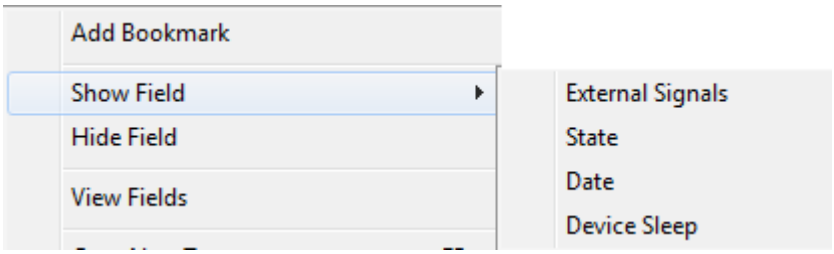


Figure 3.110: Show Field

Note: Only the fields previously hidden appear in the restore list.

Related Frames

Right-click a **Command frame** for an SSP frame, or **Register Device to Host** for an STP frame, to open a short-cut menu, then choose **Goto Response** to jump to the corresponding Response frame in the viewer.

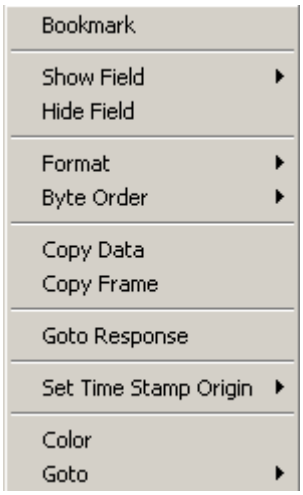


Figure 3.111: Goto Response

Similarly, right-click a **Response frame** for an SSP Frame, or **Register Device to Host** for an STP frame, to open a short-cut menu, then choose **Goto Command** to jump to the corresponding Command frame in the viewer.

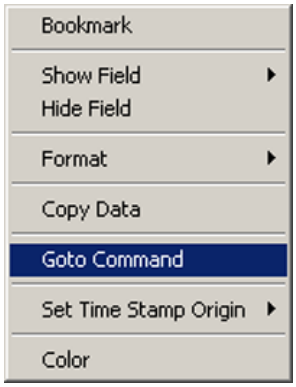


Figure 3.112: Goto Command

In Column View, you can right-click a **DWORD** inside a frame to display the **Goto Within Packet** command. You can jump to an SOF, EOF, HOLD, or R_IP.

Figure 3.113: Goto Within Packet Command

Byte Order

You can change the byte order in fields marked by an arrow and other fields.

Right-click in the field, select **Byte Order,** and choose the ordering.

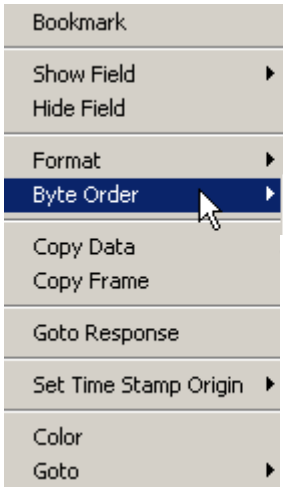


Figure 3.114: Byte Order

Note: A blue arrow in the byte order field indicates that it has been changed.

Choose Data Format

You can display data values either in hexadecimal (default) or binary. To choose data format, right-click the mouse over a data field, and choose **Format** and the format (see Figure 3.115 on page 283).

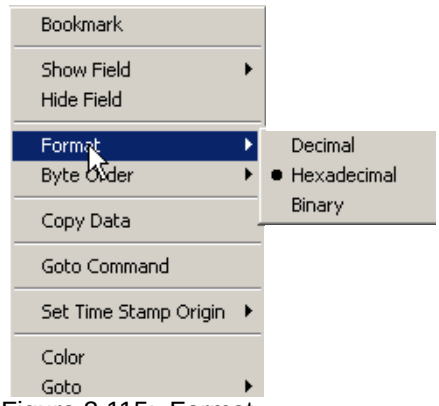


Figure 3.115: Format

Show All Data

To display all captured data, click the **data expand** toggle arrow in a data field, to examine the data in detail.

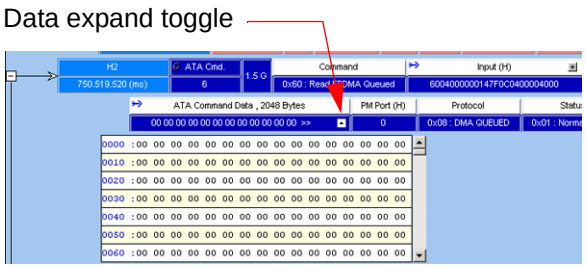


Figure 3.116: Show All Data

You can expand or collapse all data fields globally. To expand all data fields, right-click the mouse in a data field and choose **Expand All.**

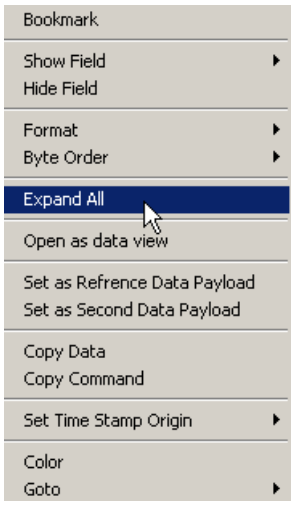


Figure 3.117: Expand All

To collapse all fields, right-click the mouse in a data field and choose **Collapse All.**

You can expand or collapse all FIS's and commands. To expand, right-click the mouse in a data field and choose **Expand All FIS's** or **Expand All ATA Cmd.s.** See Figure 3.118 on page 284.

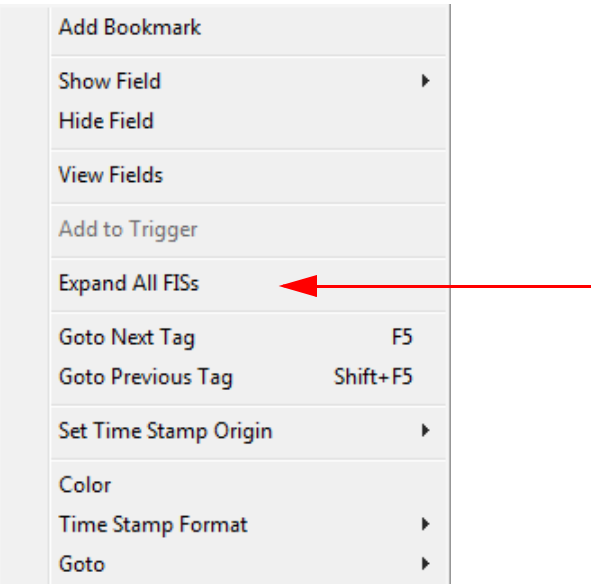


Figure 3.118: Expand All FIS's

To collapse, right-click the mouse in a data field and choose **Collapse All FIS's** or **Collapse All ATA Cmd.s.**

You can expand or collapse specific packets and commands by clicking on the or buttons (see Figure 3.119 on page 284).

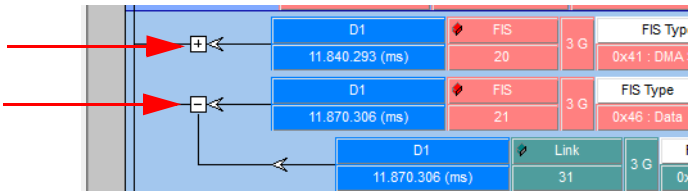
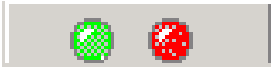


Figure 3.119: Expand/Collapse Specific Layers.

3.7 Port Status

You can get an overview of the active ports by clicking the **Port Status** button at the bottom right of the application window.



The Port Status displays the Port, Speed, and Analyzer.

In addition to displaying OOB, Link, Frame, and Error, a display showing the % buffer full opens when a trigger occurs.

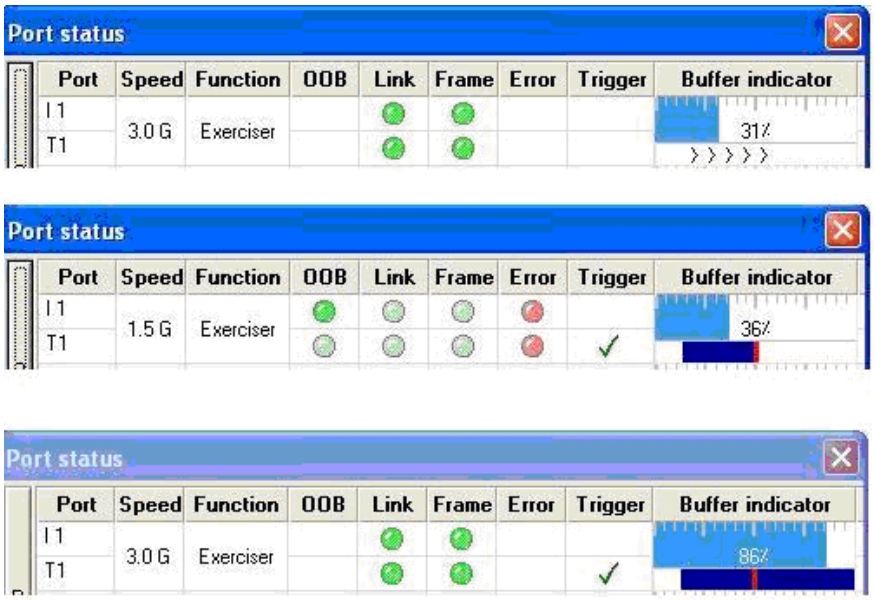
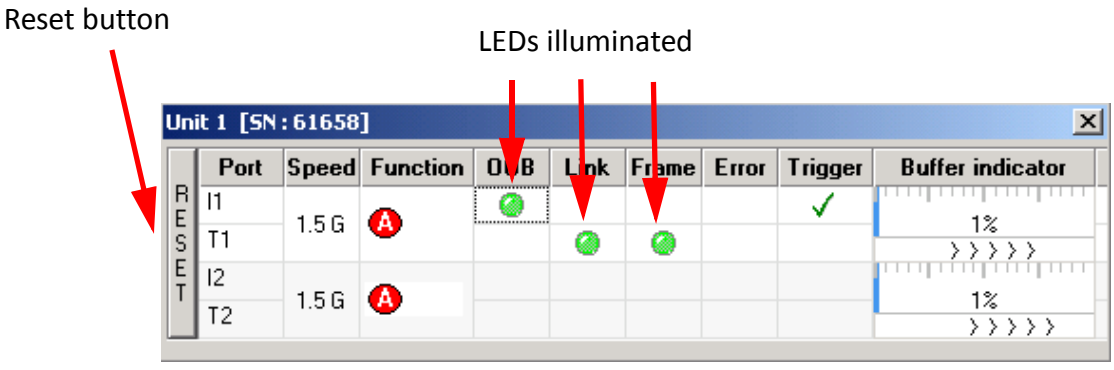


Figure 3.120: Port Status Window and Capturing Time

1. Pre-trig capturing (trig is 50%)
2. Trig point (shown by red bar; 36% pre trig was captured)
3. Post-trig capturing (50% post-trig was captured and capturing has stopped)

Note: If sample capture occurs with more than one unit active, additional Port Status windows display.

The OOB, Link, Frame and Error LEDs in the Port Status dialog mimic/follow the LEDs on the Front panel of the unit.

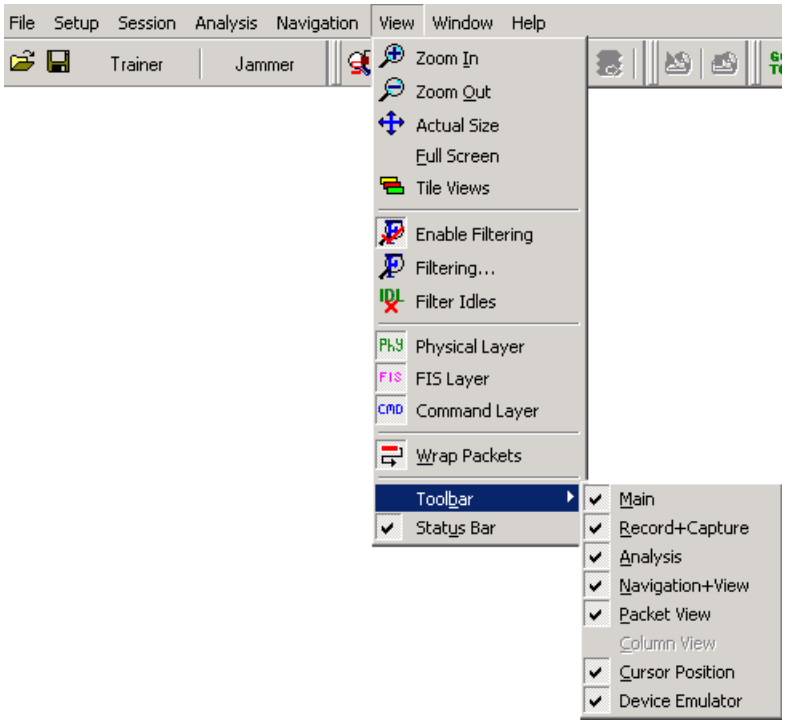


When the LEDs are dim, it indicates they were lit in the past. Pressing the Reset button erases this history and the illuminated LEDs are removed from the dialog.

3.8 Toolbars

3.8.1 Enabling Tool Bars

To customize the Viewer Display workspace, you can enable and reposition the available toolbars. To display or hide toolbars, select **View > Toolbar**, then check or uncheck toolbars**.**



Toolbars are:

- Main
- Record + Capture
- Analysis
- Navigation + View
- Packet View
- Column View
- Cursor Position
- Device/Target Emulator

Once enabled, the toolbars can dock at the Viewer Display window or float on the windows desktop.

3.8.2 Cursor Position Status Bar

To display the cursor position status bar, select **Toolbar > Cursor Position**.

Figure 3.121: Cursor Position Toolbar

See “Using the Cursors and Bookmarks” on page 287.

3.9 Status Bar

The Status bar is located at the bottom of the main display window.

3.9.1 Search Status

The right most segment displays the current search direction: **Fwd** (forward) or **Bwd** (backward). Change the search direction from the Search Menu or double-click the Search Status segment.

3.10 Using the Cursors and Bookmarks

3.10.1 Cursors

The data viewer display incorporates three cursors labeled **X, Y,** and **T.** All cursors are initially overlaid and positioned at location 0, which is the trigger position of the display. The Trigger, or **T**, cursor is the measurement reference and is always at location 0 in the display.

Positioning the X Cursor

To position the X-Cursor within the viewer data display, click the left mouse button in the gray bar on the left side of the sample viewer next to the line in which to place the cursor.

Positioning the Y Cursor

To position the Y-cursor within the viewer data display, click the right mouse button in the gray bar on the left side of the sample viewer next to the line in which to place the cursor.

Note: You can also left-click to set the X-cursor and right-click to set the Y cursor in the Frame and Column View by clicking in the narrow strip on the very left side of a cell. Similarly, you can set the cursors in the Waveform View by left and right clicking at the beginning of a waveform.

Time

Time differences between the cursors are displayed in the Cursor Position toolbar. To display the cursor position toolbar, select **Toolbar** from the view menu and choose Cursor Position.

Figure 3.122: Cursor Position Toolbar

3.11 Display Configuration

The Analyzer ships with a default display configuration of field and viewer settings. You can define your own field and viewer settings for a particular testing scenario. Right-click in the Packet View and select **Software Settings**. The Trace Viewer Configuration dialog displays (see Figure 3.123 on page 289).

3.11.1 Trace Viewer Configuration

The Trace Viewer Configuration dialog (see Figure 3.123 on page 289) allows you to change the following display settings:

- Field Setting
  - Format (Decimal, Hexadecimal, Binary)
  - Visible
  - Byte Order (Right Align, Left Align)
- Field Header Setting
  - Text (color)
  - Name
  - Abbreviation
  - Foreground (color)
- Viewer Setting
  - Wrap Packet
  - Enable Tooltips
- Data Payload
  - Columns in Row (1, 2, 4, 8, 16)
  - Bytes in Column (1, 2, 4, 8, 16)
- Time Stamp Origin: Absolute, Trigger, User Defined, Based on System Time
- Same color for start time and port
- Enable Packet View Condense Mode
- Time Stamp Format (LeCroy, Milli, Micro)
- Save Trace Viewer Configuration in a file
- Load Sample Viewer Configuration from a file
- Factory Setting (restores default settings)
- Font (opens Font dialog)

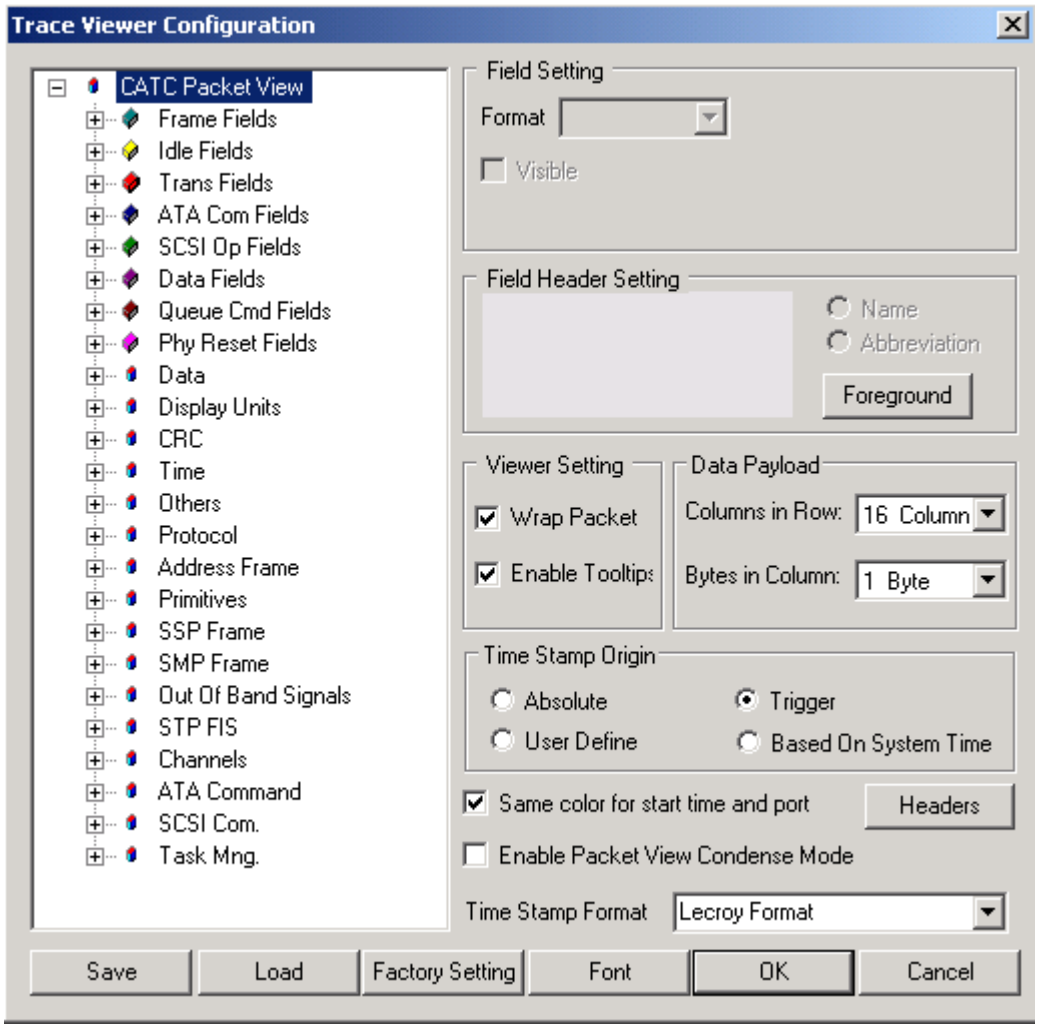


Figure 3.123: Trace Viewer Configuration

Field Settings

To view a packet field, select a field from the packet field tree and check the **Visible** box. Uncheck it to hide the field. To change the data format of a packet field, select the field and choose a data format from the Format drop-down list.

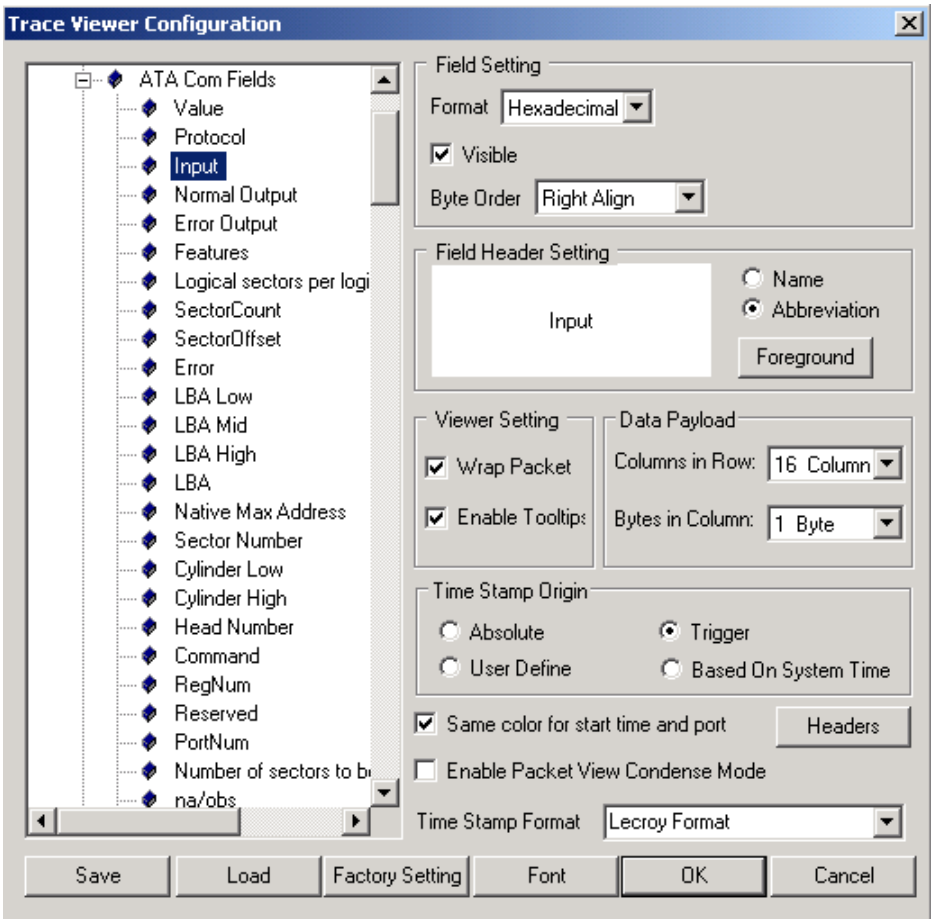


Figure 3.124: ATA Command Fields

Field Header Setting

You can use the Name or Abbreviation.

To change the color of the text in a packet field header, select a field from the packet field tree and click the **Foreground** button.

Figure 3.125: Color

Choose an appropriate color and click **OK.**

Viewer Setting

Check the **Wrap Packet** box to enable the wrapping of packets in the display.

Check the **Enable Tooltip** box to enable tool tips for packet fields.

Data Payload

You can format the Data Payload display.

For Columns in Row, select 1, 2, 4, 8, or 16.

For Bytes in Column, select 1, 2, 4, 8, or 16.

Time Stamp Origin

Select Absolute, User DEfined, Trigger, or Based on System Time.

Start Time and Port

You can use the same color for the start time and port.

Packet View Condense Mode

You can enable Packet View Condense Mode to minimize Packet View rows.

Time Stamp Format

Select LeCroy, Milliseconds, or Microseconds.

Font

To change display fonts, click the **Font** button to open the Font dialog box.

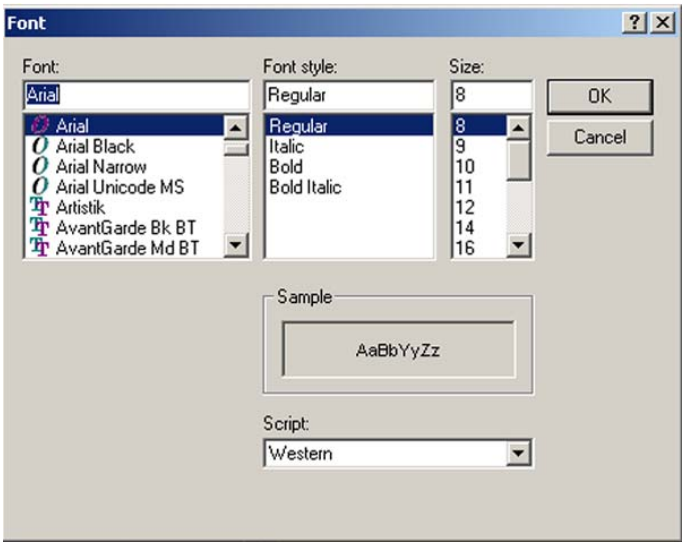


Figure 3.126: Font

Choose the font, font style, and size, and click **OK.**

Save/Load Settings

You can save the customized configuration settings in a ***.cfg** file by clicking the **Save** button and completing the Save As procedure. To load a previously saved configuration file, click **Load** and choose an appropriate file.

3.12 Set Port Alias

Port Alias allows you to assign a meaningful name to each port to assist in interpreting the results displayed in the sample view (see Figure 3.127 on page 293).

To assign port names in an open sample view, select **Setup > Set Port Alias**.

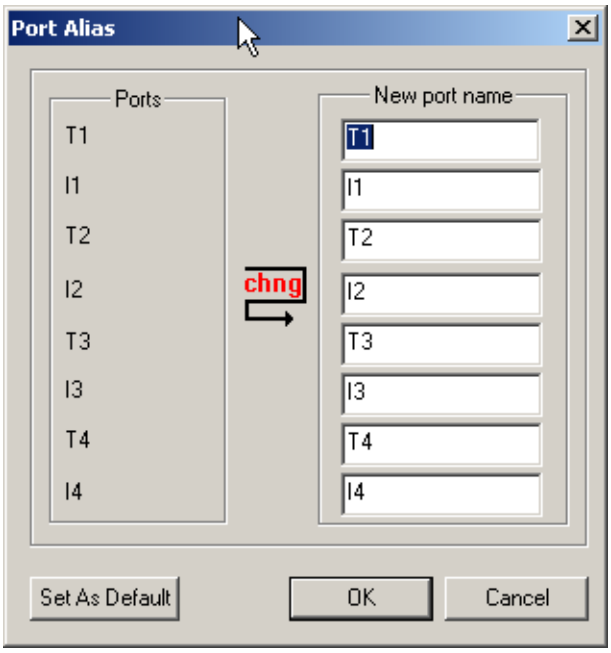


Figure 3.127: SAS: Assign Port Alias

Assign a meaningful name to each port in use and click **OK**. The assigned names replace the port numbers in the sample view.

If you elect to save the capture sample file, the assigned port names are saved together with the result, so that when you open the sample file later, the assigned names are retained.

Set As Default

If you want to set these port aliases for sample files that will be captured later, you can set them as default, and new samples will be opened by these default port aliases.

3.13 SAS Address Alias (SAS only)

SAS Address Alias allows you to assign a meaningful name to each SAS address to assist in interpreting the results displayed in the sample view. To assign SAS address names in an open sample view, select **Setup > Set SAS Address Alias** (see Figure 3.128 on page 294).

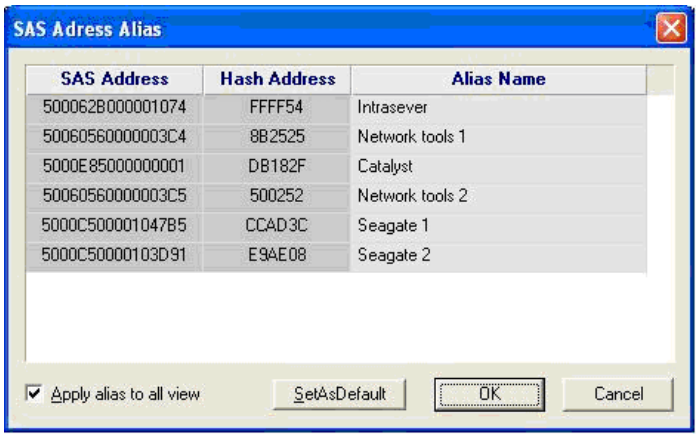


Figure 3.128: SAS: Assign SAS Address Alias

Assign a meaningful name to each SAS address in use and click **OK**. The assigned names replace the SAS address in the sample view, Search, filter, and Statistical report.

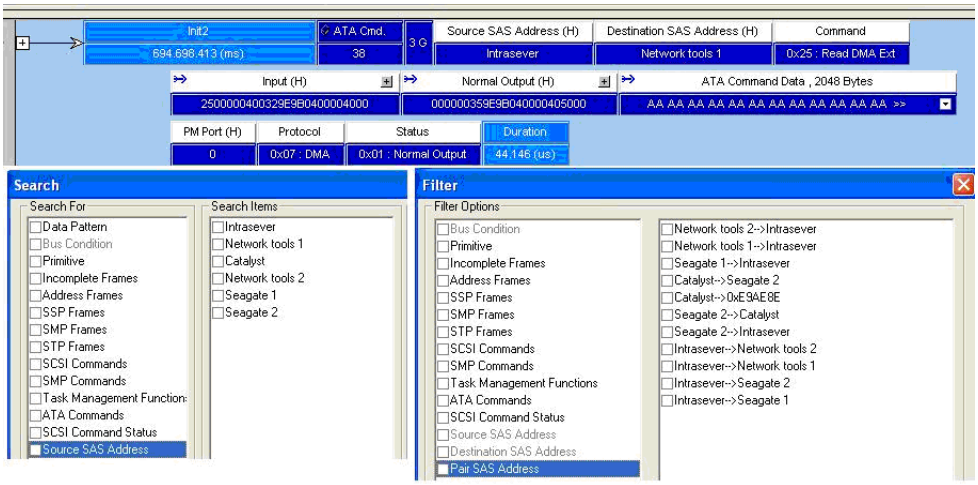


Figure 3.129: SAS: SAS Address Alias

If you elect to save the captured sample file, the assigned SAS address names are saved together with the result, so that when you open the sample file later, the assigned names are retained.

Set As Default

If you want to set these SAS address aliases for sample files that will be captured later, you can set them as default, and new samples will be opened by these default SAS address aliases.

3.14 TxRx Vout & Preemphasis

The analyzer incorporates the ability to select TX Vout for the transmitter on each port. Selecting TX Vout increases the output voltage swing above the nominal value, for test and characterization purposes. This feature is also useful to compensate for line loss when driving long cables.

To select TX Vout, select **Setup > TxRx Vout & Preemphasis** to display the Rx/Tx Settings dialog.

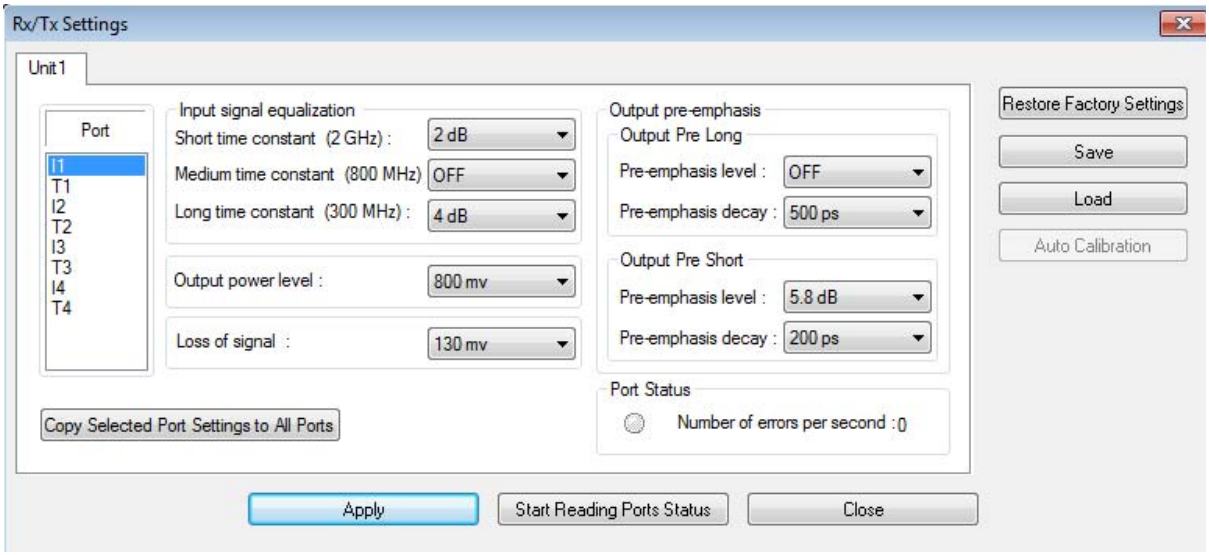


Figure 3.130: Choose Port for TXRx Vout

Port displays ports to select from.

Copy Selected Port Settings to All Ports implements one port's setting into all other port settings.

Input signal equalization allows you to select values for Short time constant, Medium time constant, Long time constant, Output power level and Loss of signal from the drop-down menu.

Output pre-emphasis:

Output Pre Long allows you to select values for Pre-emphasis level, Pre-emphasis decay, from the drop-down menu.

Output Pre Short allows you to select values for Pre-emphasis level, Pre-emphasis decay, from the drop-down menu.

Port Status displays number of errors per second.

Apply applies the selected settings.

Start Reading Port Status implements reading of number of errors displayed in Port Status.

Restore Factory Settings restores default values.

Save saves the new values as a ***.sng** file.

Load loads back the saved ***.sng** file.

3.15 Preferences

Preferences allow you to define template files for new Analyzer projects, to specify how sample files appear when opened, and to set ATAPI and SCSI Spec Assignments.

To perform settings in an open trace view, select **Setup > Preferences**.

3.15.1 General Tab

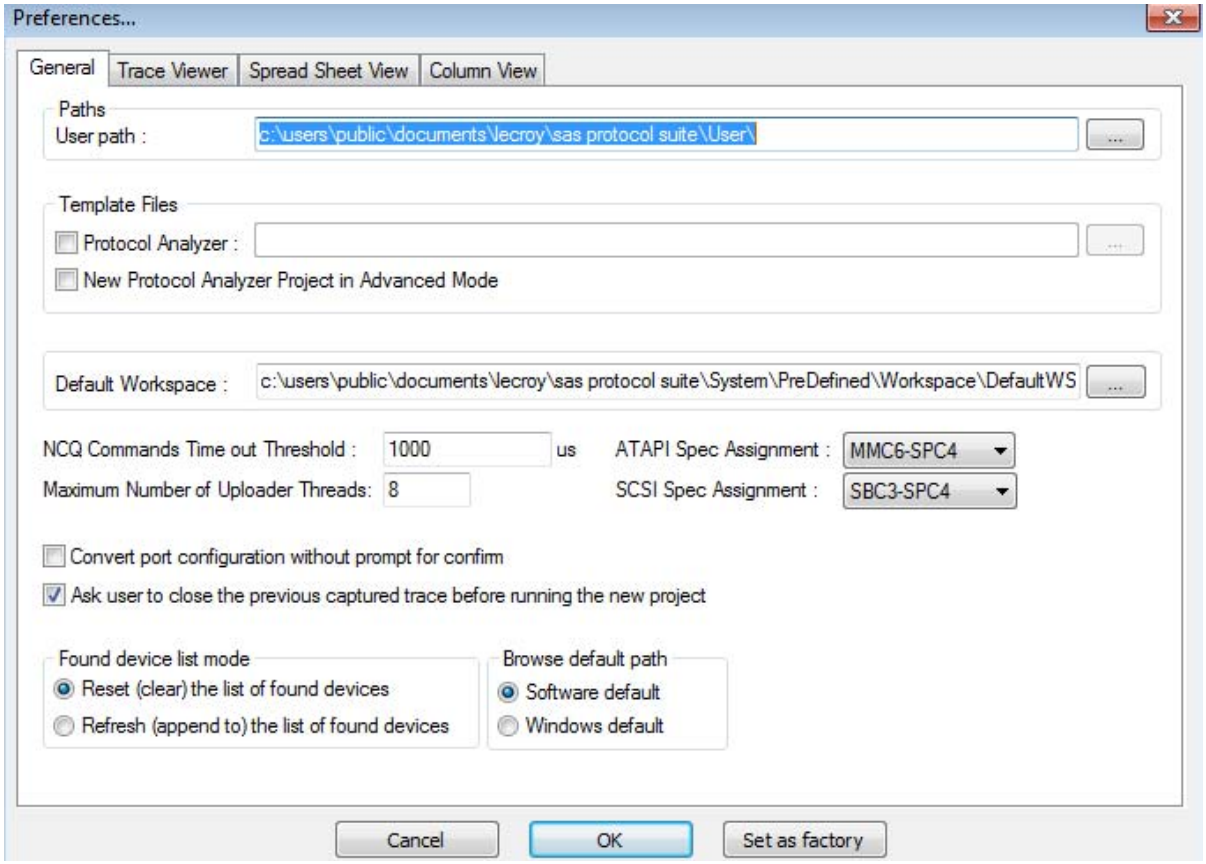


Figure 3.131: SAS: Preferences Dialog General Tab

The SATA Preferences dialog has the same options, except that it does not have "SCSI spec assignment".

Paths

User Path specifies the "User" folder path, used by the software after launching the Open dialog.

Template Files

Protocol Analyzer: You can use a pre-saved analyzer and/or analyzer/emulator project file as a template. Whenever you make a new project file, the software uses the template to initialize the project file.

New Protocol Analyzer Project in Advanced Mode: When you use the New menu item to create a new project file, the software switches to Advanced mode automatically.

Other

Default Workspace specifies the default workspace file for opening a sample file. You can save any viewer configuration as a workspace and then specify it as the default workspace. The software always open a trace file based on the default workspace file.

NCQ Commands Time out Threshold: The software uses this setting in the statistical ATA command page for NCQ commands. If the time out exceeds this setting, the software reports an error.

Maximum Number of Uploader Threads: If Quick View is not enabled, during cascading, specifies the number of concurrent processes for uploading a sample file.

ATAPI spec assignment: Specifies the ATAPI default spec.

SCSI spec assignment (SAS only): Specifies the SCSI default spec.

Convert port configuration without prompt for confirm: If the current attached board does not support the project file port configuration, the software converts it to a supported port configuration without asking for confirmation. If this setting is unchecked, the software asks for confirmation

Ask user to close the previous captured sample before running the new project: When you start to run a new project, the software prompts you to close the current sample.

Found Device List Mode

Reset (clear) the list of found devices: Lists only the currently found devices.

Refresh (append to) the list of found devices: Adds new devices to the list of devices found previously.

Browse Default Path

Software default: After you select **File > Open**, the Open dialog shows the default user folder.

Windows default: After you select **File > Open**, the Open dialog shows the path selected when the Open dialog was last used.

3.15.2 Trace Viewer Tab

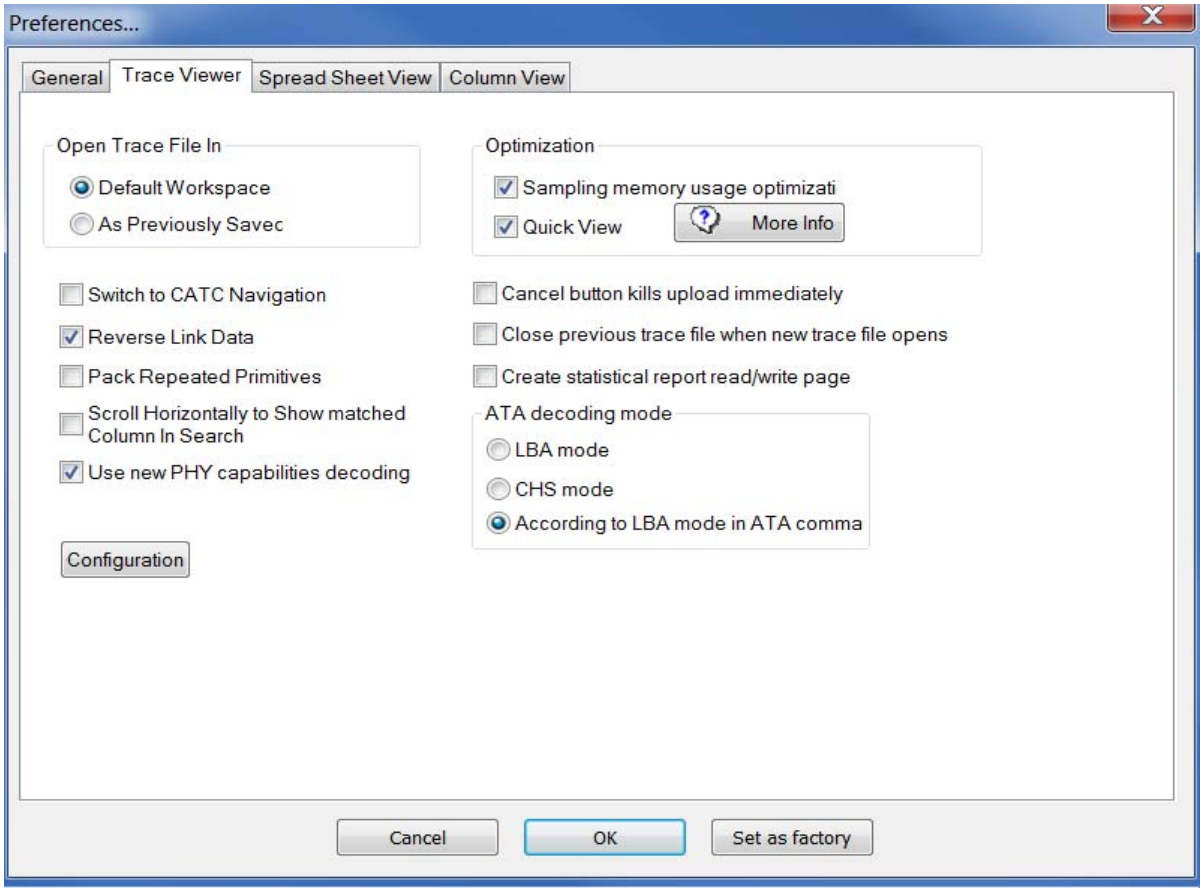


Figure 3.132: SAS: Preferences Dialog Trace Viewer Tab

The SATA Preferences dialog has the same options.

Open Trace file In

Default Workspace: The software opens a **trace** file in view(s) based on the specified default workspace.

As previously saved: The software opens a **trace** file in view (views) based on the last saved configuration for the **trace** file.

Optimization

Sampling memory usage optimization: Enables memory cascading for two ports. The analyzer will use memory of another port if there is not data on another port. (see "Sampling Memory Usage Optimization" on page 303)

Quick View: Quick View allows full access to the whole trace more quickly, especially when using a Gigabit Ethernet connection. However, the trace is NOT written to the host machine's hard drive. To save the trace, you must manually click **Save**.
If you do not check Quick View, the trace loads more slowly but is automatically saved to the host machine's hard drive.

Other

Switch to CATC Navigation: Packet view will open in CATC mode.

Reverse Link Data: The software shows DWORDs of link data as reversed.

Pack Repeated Primitives: The software packs repeated primitives just after opening a sample file.

Scroll Horizontally to Show matched Column in Search: When unchecked makes columns stationary even during search.

Use new PHY capabilities decoding: Checking this box sends the first bit as bit # 7. Leaving the box unchecked sends the first bit as bit # 0.

Cancel button kills upload immediately: The software kills the uploading process if you press **Cancel**.

Close previous sample file when new sample file opens: When you want to open a new sample file, the software closes any open sample files.

Create statistical report read/write page: The software creates a Read/Write page in the statistical report. Enabling this setting displays the **Read/Write Stream DMA** command in the Read/Write page.

LBA mode: Checking this box enables LBA mode for ATA decoding.

CHS mode: Checking this box enables CHS mode for ATA decoding.

According to LBA mode in ATA command: Checking this box enables decoding according to LBA mode in ATA command for ATA decoding.

Configuration: Clicking **Setup** displays the Trace Viewer Configuration dialog (see Figure 3.133 on page 300).

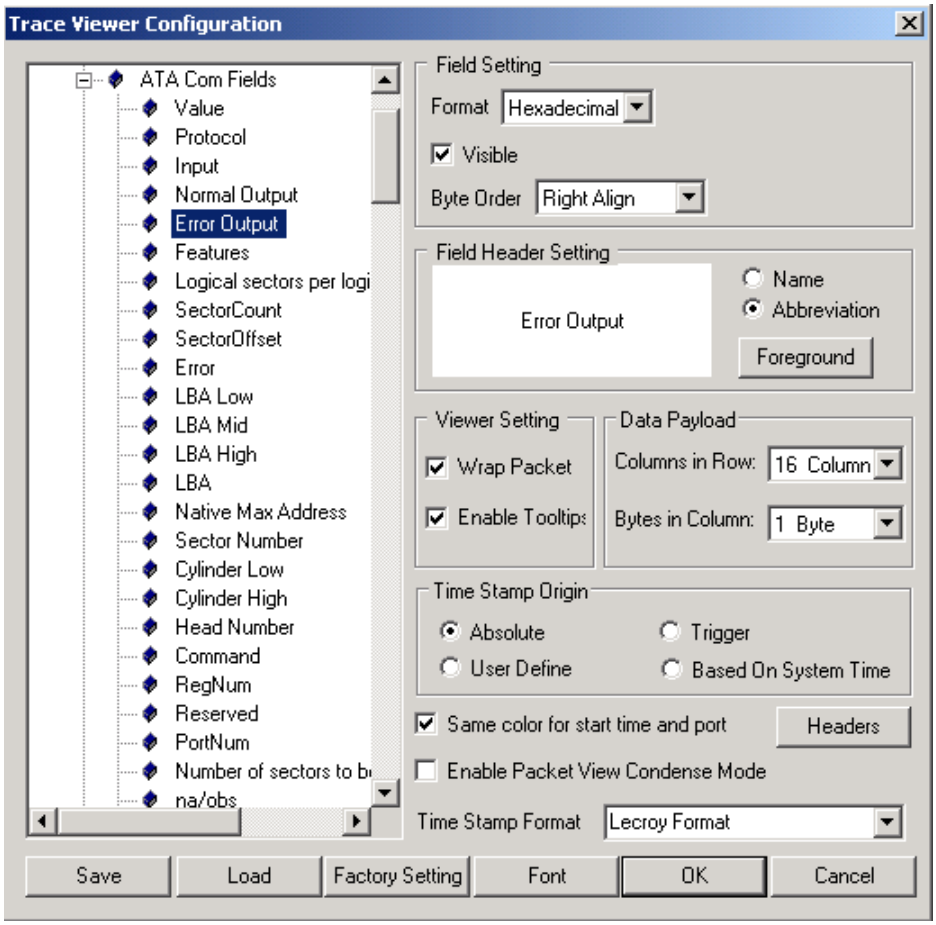


Figure 3.133: SATA: Preferences trace Viewer Configuration Dialog

Select a view in the left pane and set the trace viewer display options in the right pane.

3.15.3 Spread Sheet View Tab

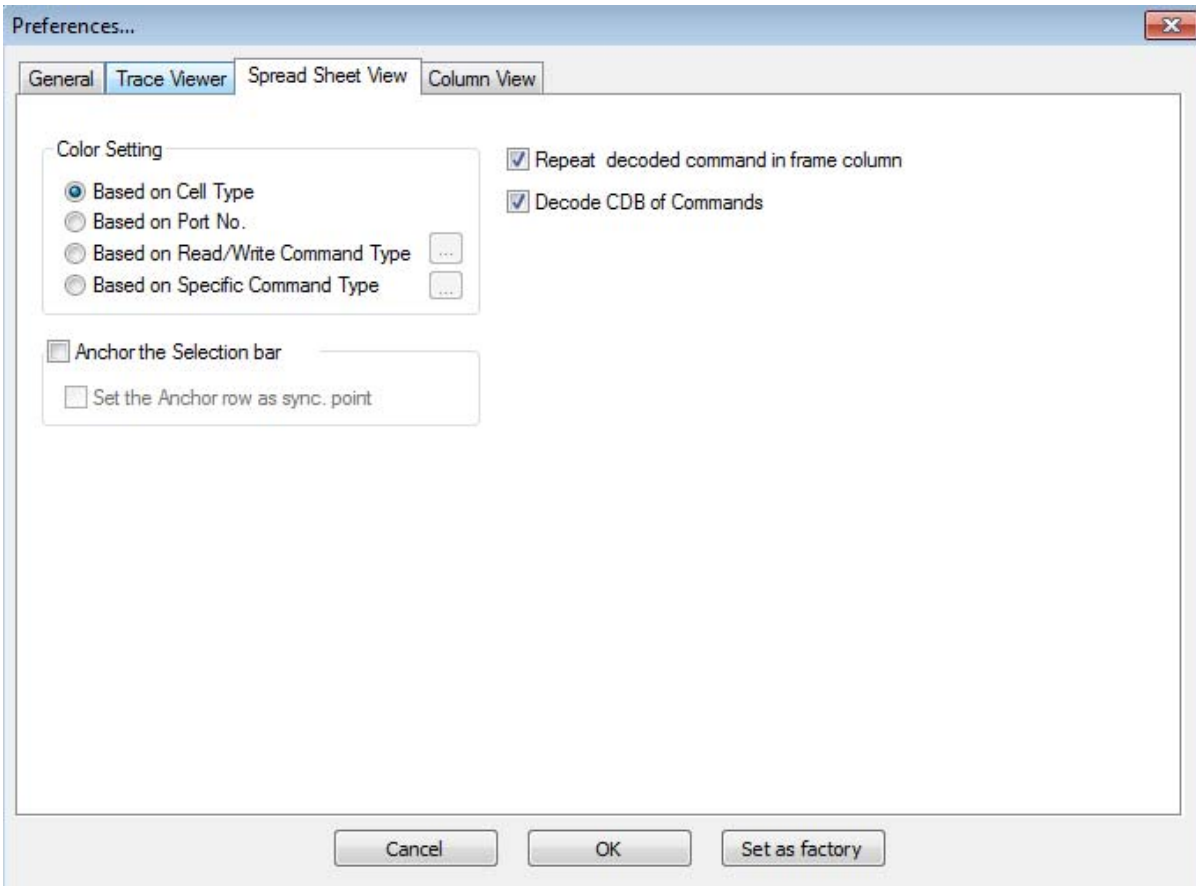


Figure 3.134: SATA: Preferences Dialog Spread Sheet View Tab

The SAS Preferences dialog has the same options, except that it does not have “Show ‘Sector Count’ instead of ‘Xfer Length”.

Color Setting

Based on Cell Type: Each column has its own color.

Based on Port No.: Data of each row are shown based on the specified color for its port. You can set the color of ports in the Viewer settings.

Based on Read/Write Command Type: You can specify a color for Read commands, another color for Write commands, and other color for other commands. The software shows each row based on the command type: Read, Write, or others.

Based on Specific Command Type: You can specify a color for each command. The software applies the setting on the Command column.

Anchor the Selection bar

You can anchor the selection bar of the Spreadsheet View.

Set the Anchor row as sync. point: Other views synchronize based on the contents of the anchor row.

Other

Repeat decoded command in frame column: The spreadsheet shows the name of the command in front of all frames in the Command column. Otherwise, it will show the name of the command only in front of the SSP command frame.

Decode CDB of Commands: The spreadsheet shows name of command in command column, otherwise shows CDB of command in command column.

Show 'Sector Count' instead of 'Xfer Length' (SATA only): Display sector count.

3.15.4 Column View Tab

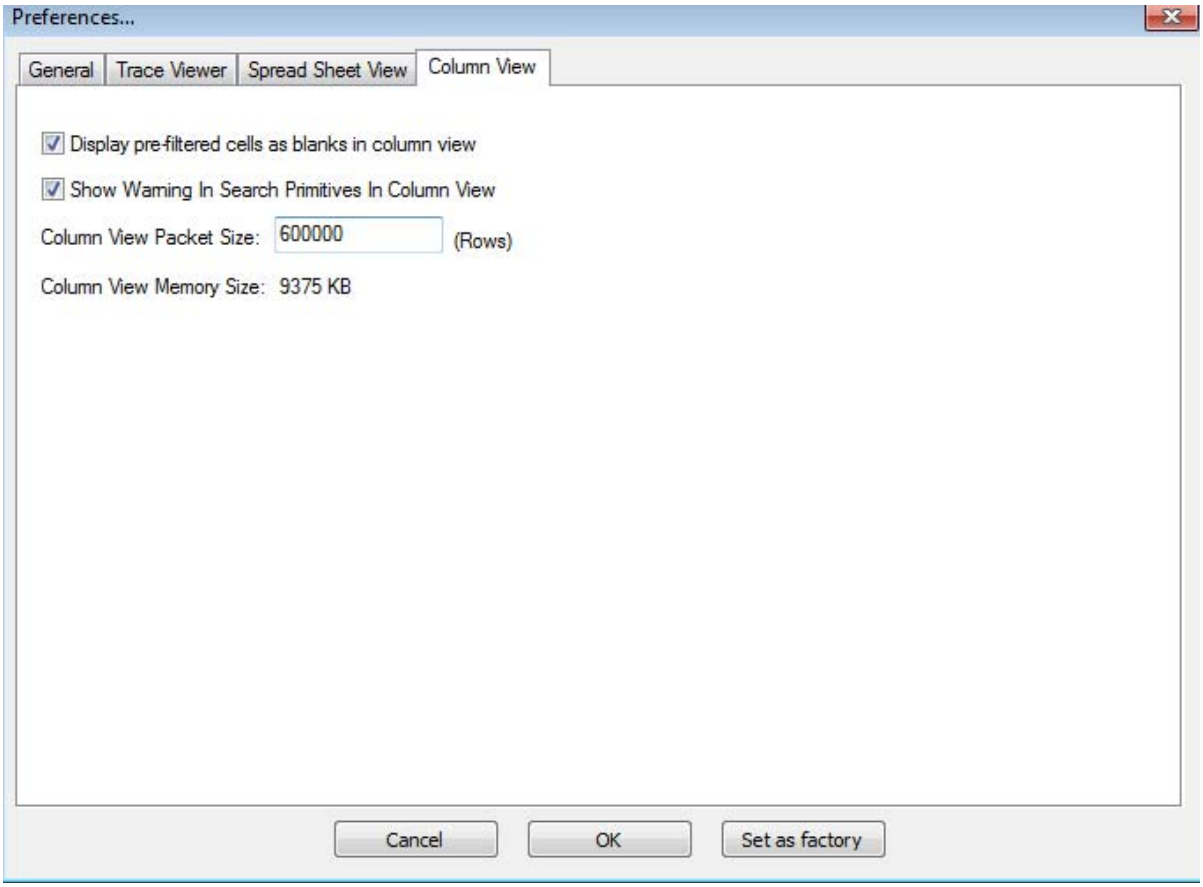


Figure 3.135: SAS: Preferences Dialog Column View Tab

The SATA Preferences dialog has the same options.

Other

Display pre-filtered cells as blank in column view: The software shows pre-filtered data (already filtered in the capture project), as blank cells. Otherwise, it will show them as "pre-filtered" cells.

Show Warning in Search Primitive In Column View: If searching in Column View takes a long time, the software asks if you want to continue search. Otherwise, the software continues searching with no pause.

Column View Packet Size: Specifies the allocated buffer for showing rows of a packet in Column View: When you see "Too Large" in a Column-View cell, the current allocated buffer is not enough and you should increase it by changing this setting.

Column View Memory Size: Displays the memory buffer.

3.15.5 Sampling Memory Usage Optimization

The Preferences dialog has a Sampling Memory Usage Optimization option. This Memory Assignment (MA) feature optimizes sampling memory utilization.

If the Sampling Memory Usage Optimization Option is Checked

The system tries to use empty space in all memory banks to prevent any memory bank from filling completely. Each physical link is not necessarily assigned to a specific memory bank. The system can capture more sample data than if the MA option is unchecked, and sample file size is closer to the user-defined Sampling Memory Size.

Memory Assignment efficiency varies with Port Configuration and Trigger Position:

- **FPGA**: The Memory Assignment feature works for a pair of ports connected to one FPGA, for example ports 1 and 2 (or ports 3 and 4). Memory Assignment does not work for two ports connected to different FPGAs, for example ports 1 and 3.
- **Triggering**: Memory Assignment only starts after the trigger point. During pre-trigger, each physical link is always assigned to a specific memory bank. Post-trigger, the system can try to use empty space in all memory banks, if you check the MA option. Therefore, Memory Assignment efficiency is maximum when Trigger Position is set to 0% (snap-shot trigger) and is minimum when Trigger Position is set to 99% or when there is no triggering (you stop recording manually).
- **MUX**: When MUX is enabled, each segment has four memory banks, limiting Memory Assignment somewhat.

Here are examples of different Port Configurations and Trigger Positions:

- **One port configuration (A - - -):** Sample size is user-specified sample size.
- **Two port configuration (AA - -)**: Ports 1 and 2 are on the same FPGA, so Memory Assignment has an effect. If you use snapshot triggering, the sample size is near specified size.
- **Two port configuration (AA - -):** If you use manual stop, Memory Assignment has no effect. Sample size depends on port traffic loads.
- **Two port configuration (AA - -)**: If trigger is set at 50%, and there is enough data to fill pre-trigger, Memory Assignment has an effect. Sample size is typically near specified size.
- **Two port configuration (AA - -)**: If trigger is set at 50%, but there is not enough data to fill pre-trigger, Memory Assignment has an effect. Sample size is typically more than half specified size, with size determined by the amount of data captured before trigger.
- **Two port configuration (A - A -)**: Ports 1 and 3 are not on the same FPGA, so Memory Assignment has no effect. If one port has heavy traffic, it may fill its memory bank and stop recording, resulting in smaller sample size than specified.

Note: Checking this option does not affect the sample. It only allows larger sample sizes.

Note: If traffic is balanced on ports, sample size is the same whether you check or uncheck the Sampling Memory Usage Optimization option.

Note: Memory Assignment depends on traffic load distribution at the time when the system tries to re-assign physical links to memory banks. Therefore, if you repeat a capture with the same

Sampling Memory Size and Segment Number parameters, the resulting sample size may not be the same. However, if traffic load distribution is similar, sample size will be similar.

Note: The buffer status indicator shows buffer by FPGA, not by port.

If the Sampling Memory Usage Optimization Option is Not Checked

Each physical link (or logical link if MUX is enabled) is assigned to a specific memory space (memory bank), depending on the Sampling Memory Size and Segment Number parameters.

Important: If **any** physical link fills its memory bank, the recording process stops. Other memory banks will typically be less than full (and can be empty). The sample file might be smaller than the user-defined Sampling Memory Size. You might even think that the Analyzer malfunctioned.

3.16 Floating License

Note: License Manager is only available when in Cascading mode. For example, if one unit is licensed only for JJ and a second unit is licensed only for AA, cascading the two units and using the License Manager allows each unit to do JA.

To manage the license, select **Setup > License Manager**.

The Floating License dialog displays (see Figure 3.109 on page 280) the available functionality by Function, Total Ports, Assigned To ports, and Not Used. It also displays the Current License Configuration by License Type, Serial Number, Analyzer, Device Emulator, Host Emulator, and InFusion.

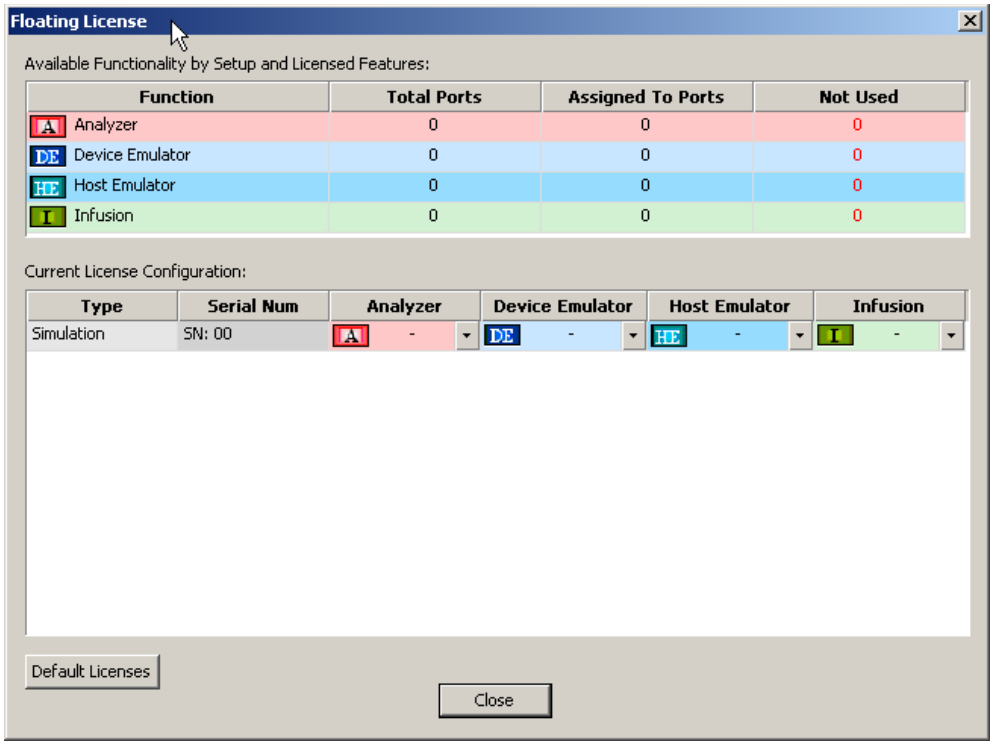


Figure 3.136: Floating License Dialog

3.17 External Trig Setting

The External Trig Setting dialog displays the External Trig Out Setting and External Trig In Setting as High Active, Low Active, or Toggle.

.

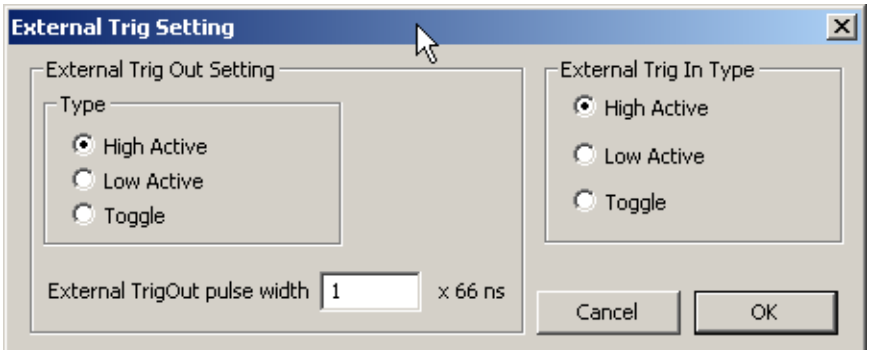


Figure 3.137: External Trigger Setting Dialog

To display the External Trig Setting dialog, select **Setup > External Trig Setting**.

External Trig Out Setting

The Analyzer can send a Low or High external signal anytime a trigger occurs. Select the External Trig Out Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Enter the External TrigOut pulse width.

External Trig In Setting

An external Low or High input signal can cause triggering. Select the External Trig In Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Note: The nominal External Trigger voltage is 0.818 volts. Trigger In can work with 1 volt to 5 volts input voltage.

3.18 Update Device

The Update Sierra Device command allows you to update a Sierra M6-2 Analyzer or CATC-Sync expansion card whose current version is incorrect.

1. Click **Setup > Update Device** to display the Device Setup dialog.

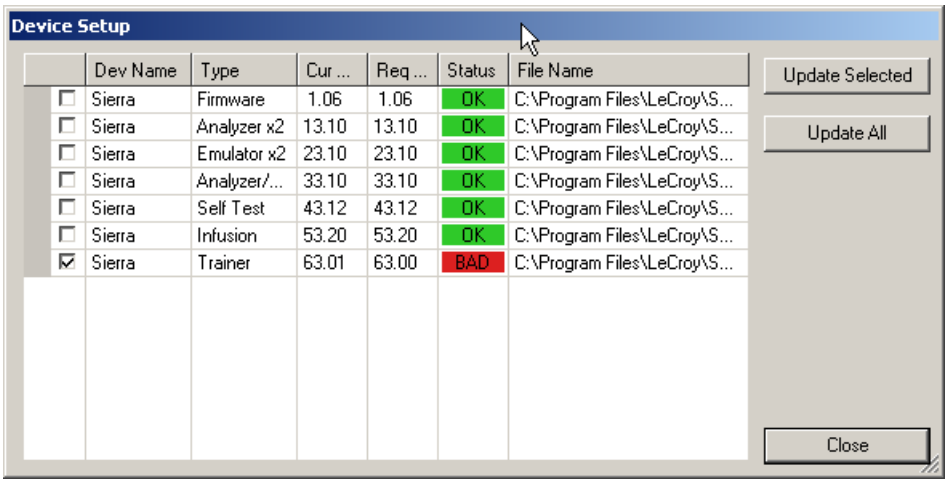

Device Setup
Dev Name
Type
Cur ...
Req ...
Status
File Name
Sierra Firmware 1.06 1.06 OK C:\Program Files\LeCroy\S...
Sierra Analyzer x2 13.10 13.10 OK C:\Program Files\LeCroy\S...
Sierra Emulator x2 23.10 23.10 OK C:\Program Files\LeCroy\S...
Sierra Analyzer/... 33.10 33.10 OK C:\Program Files\LeCroy\S...
Sierra Self Test 43.12 43.12 OK C:\Program Files\LeCroy\S...
Sierra Infusion 53.20 53.20 OK C:\Program Files\LeCroy\S...
Sierra Trainer 63.01 63.00 BAD C:\Program Files\LeCroy\S...
Update Selected
Update All
Close

Figure 3.138: Device Setup Dialog with BAD Device Status

Devices whose version is correct have an OK status.
A device whose version is incorrect has a BAD status.

Note: You can click the ellipses (...) at the end of a file path and name to display an Open dialog, in which you can browse for files.

2. Click the checkbox to the left of a device with BAD status, then click **Update Selected** to begin the process that will make the Analyzer version correct.

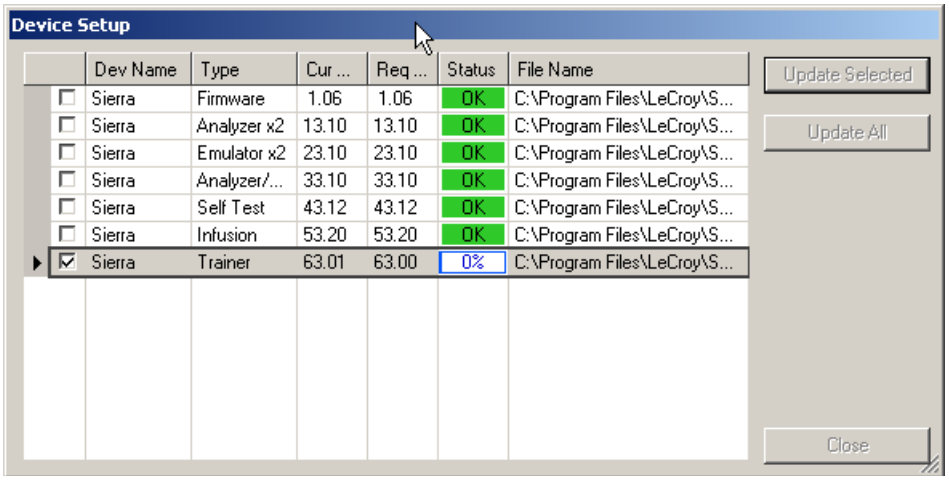

Device Setup
Dev Name
Type
Cur ...
Req ...
Status
File Name
Sierra Firmware 1.06 1.06 OK C:\Program Files\LeCroy\S...
Sierra Analyzer x2 13.10 13.10 OK C:\Program Files\LeCroy\S...
Sierra Emulator x2 23.10 23.10 OK C:\Program Files\LeCroy\S...
Sierra Analyzer/... 33.10 33.10 OK C:\Program Files\LeCroy\S...
Sierra Self Test 43.12 43.12 OK C:\Program Files\LeCroy\S...
Sierra Infusion 53.20 53.20 OK C:\Program Files\LeCroy\S...
Sierra Trainer 63.01 63.00 0% C:\Program Files\LeCroy\S...
Update Selected
Update All
Close

Figure 3.139: Device Setup Dialog Beginning to Update Status of a Device

After the update, the device must restart.

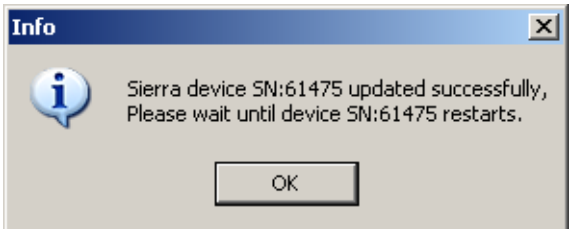


Figure 3.140: Info Dialog

Then the update is complete.

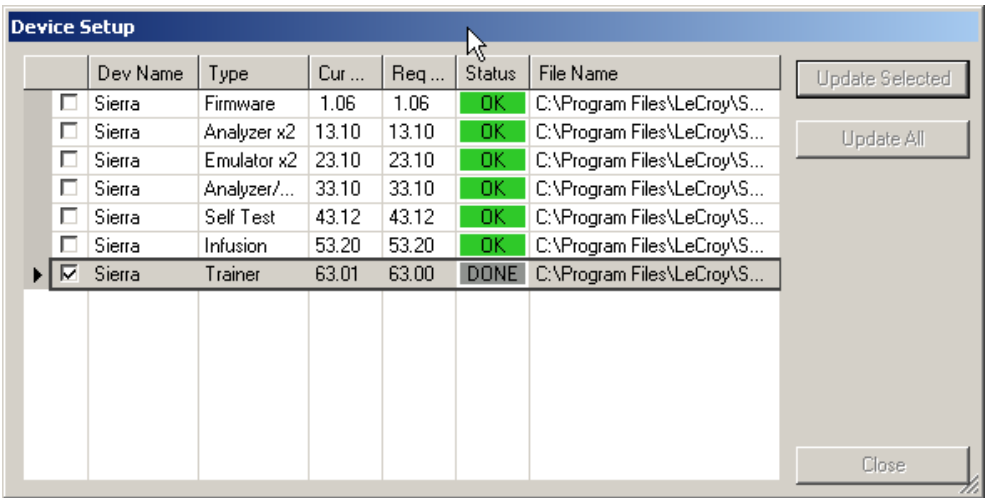

Device Setup
Dev Name
Type
Cur ...
Req ...
Status
File Name
Sierra Firmware 1.06 1.06 OK C:\Program Files\LeCroy\S...
Sierra Analyzer x2 13.10 13.10 OK C:\Program Files\LeCroy\S...
Sierra Emulator x2 23.10 23.10 OK C:\Program Files\LeCroy\S...
Sierra Analyzer/... 33.10 33.10 OK C:\Program Files\LeCroy\S...
Sierra Self Test 43.12 43.12 OK C:\Program Files\LeCroy\S...
Sierra Infusion 53.20 53.20 OK C:\Program Files\LeCroy\S...
Sierra Trainer 63.01 63.00 DONE C:\Program Files\LeCroy\S...
Update Selected
Update All
Close

Figure 3.141: Device Setup Dialog with DONE Device Status

3.19 User-Defined Decoding

User-defined decoding allows you to create a definition file to interpret commands and frames that are not in the standard set recognized by the software.

Select **Setup > User Defined Decoding** to open the User Defined Decoding dialog.

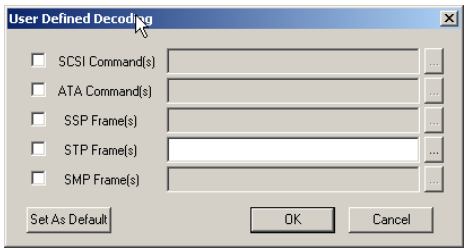


Figure 3.142: SAS: User Defined Decoding

SAS vs. SATA: SAS adds SCSI Commands, SSP Frames, and SMP Frames.

Check **ATA Commands** and/or **STP frames.** Click the ellipses next to a command type text box to display the **Open** dialog. Choose an appropriate script file and click **Open**.

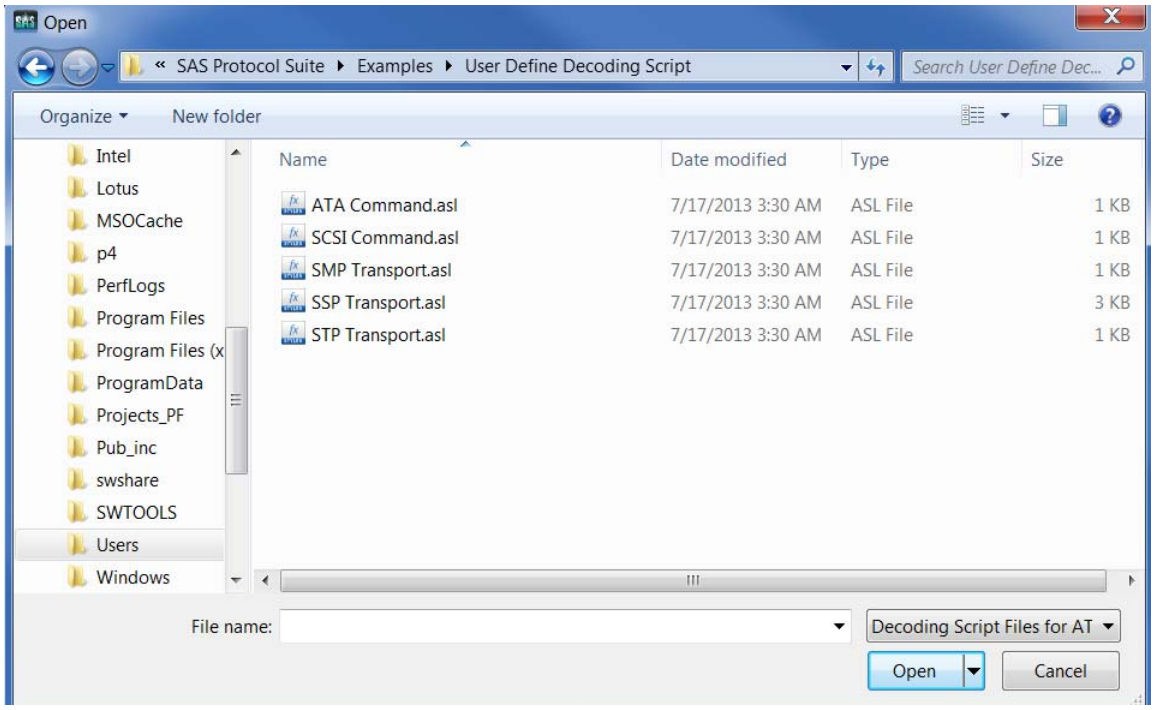


Figure 3.143: Choosing a Script File

3.20 Help Menu

3.20.1 Help Topics

Displays online help. You can also select F1.

3.20.2 VSE Help Topics

Displays VSE online help. You can also select F1.

3.20.3 Update License

A current license agreement with Teledyne LeCroy entitles the Analyzer owner to continued technical support and access to software updates as they are published on the Teledyne LeCroy website. When you obtain a license key, from the Help menu select Update License to display the Select License Key File dialog box. Enter the path and filename for the license key, or browse to the directory that contains the license key and select the *.lic file. Click Open.

3.20.4 Display License Information

Open a license information dialog to display a list of named features supported by the current software version (see Figure 3.144 on page 311.). Named features that are not enabled on your system are indicated by No in the Purchased column. Whether or not named features are enabled depends on the license key stored in your analyzer. If you try to use a feature for which you do not yet have a license, the program displays the License Protection Message. To use the feature, you must purchase a license.

Licensing
Hamilton: (S/N : 61658 (0xF0DA))
License information for the product, Serial Number 61658 (0xF0DA) :
Software mainten
Available Features
Feature Title | Purchased | Feature Description
System Memory Size: 1GB | No | Enable operation with 1GByte of internal memory.
System Memory Size: 2GB | No | Enable operation with 2GByte of internal memory.
System Memory Size: 4GB | Yes | Enable operation with 4GByte of internal memory.
System Memory Size: 8GB | No | Enable operation with 8GByte of internal memory.
System Memory Size: 16GB | No | Enable operation with 16GByte of internal memory.
Rate Support: 1.5G | Yes | Support for 1.5GBps data rate.
Rate Support: 3G | Yes | Support for 3GBps data rate.
Rate Support: 6G | Yes | Support for 6GBps data rate.
Tool: Pattern Generator | Yes | Enable Pattern Generator.
Tool: SATA Compliance | Yes | Enable SATA Compliance.
Tool: SATA Host Emulator | Yes | Enable SATA Host Emulator
Tool: SATA Device Emulator | Yes | Enable SATA Device Emulator.
Tool: SAS Initiator Emulator | Yes | Enable SAS Initiator Emulator.
Tool: SAS Traget Emulator | Yes | Enable SAS Target Emulator.
Protocol Support: SAS | Yes | Support for SAS protocol.
Protocol Support: SATA | Yes | Support for SATA protocol.
Protocol Support: STP | Yes | Support for STP in SAS protocol.
Protocol Support: Pre-emphasis | Yes | Support for Pre-emphasis for SAS and SATA protocols.
Analysis ports: 1 | Yes | Enable one analysis port for blade.
Analysis ports: 2 | Yes | Enable two analysis ports for blade.
Analysis ports: 4 | Yes | Enable four analysis ports for blade.
Analyzer Feature: Muxing | No | Enable Muxing in analyzer.
Device/Target Emulator Ports: 1 | Yes | Enable one port for SATA Device or SAS Target.
Device/Target Emulator Ports: 2 | Yes | Enable two ports for SATA Device or SAS Target.
Device/Target Emulator Ports: 4 | Yes | Enable four ports for SATA Device or SAS Target.
Host/Initiator Emulator Ports: 1 | Yes | Enable one port for SATA Host or SAS Initiator.
Host/Initiator Emulator Ports: 2 | Yes | Enable two ports for SATA Host or SAS Initiator.
Host/Initiator Emulator Ports: 4 | Yes | Enable four ports for SATA Host or SAS Initiator.
Emulator Feature: Muxing | No | Enable Muxing in Emulator.
Trainer Ports: 1 | Yes | Enable one Trainer port for blade.
Trainer Ports: 2 | Yes | Enable two Trainer ports for blade.
Trainer Ports: 4 | Yes | Enable four Trainer ports for blade.
Infusion Ports: 1 | Yes | Enable one Infusion port for blade.
Infusion Ports: 2 | Yes | Enable two Infusion ports for blade.
Infusion Ports: 4 | Yes | Enable four Infusion ports for blade.
Infusion Feature: Muxing | Yes | Enable Muxing in Infusion.
Save As...
Close

Figure 3.144: Licensing Dialog

3.20.5 Check for Updates

Check whether a new software version is available. If so, you can download from the Teledyne LeCroy web site.
You can select to Check for updates at application startup.

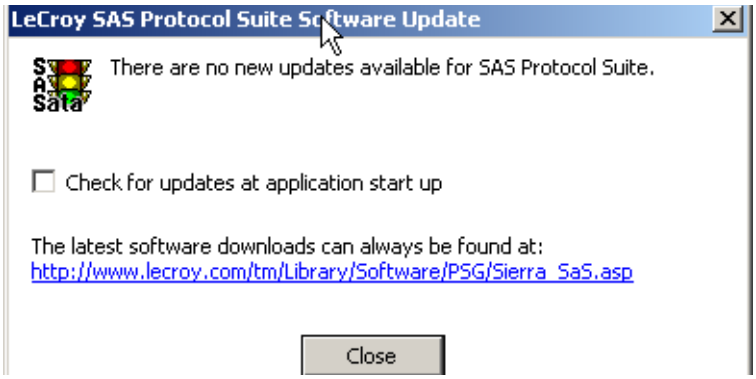

LeCroy SAS Protocol Suite Software Update
There are no new updates available for SAS Protocol Suite.
Check for updates at application start up
The latest software downloads can always be found at:
http://www.lecroy.com/tm/Library/Software/PSG/Sierra_SaS.asp
Close

Figure 3.145: Check for Updates

3.20.6 About

Displays version information.

3.21 Setup Menu

3.21.1 Self Test

You can use the built-in RAM self-test utility. Select **Setup** on the main menu bar and choose **Self Test** to open the Self Test dialog.

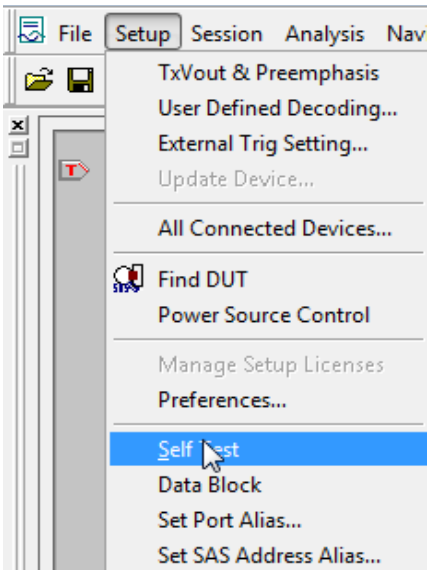


Figure 3.146: SAS: Self Test Command on Tools Menu

3.21.2 Clock Check

To perform a Clock check, choose the clock to test and click the **Start Clock Check** button. After a short time, the Test Result appears to the right of the selected line.

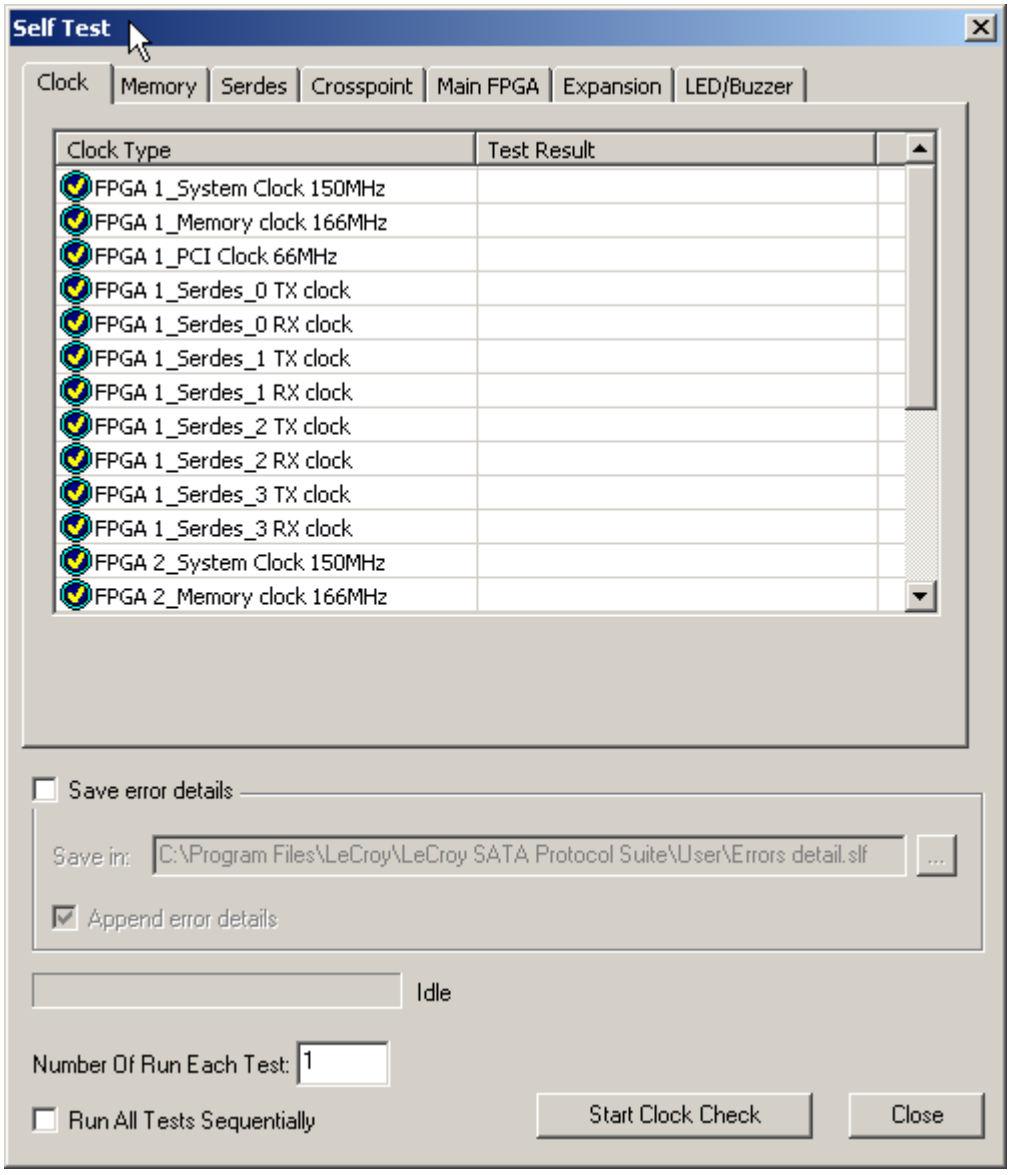


Figure 3.147: SATA: Self Test Dialog Clock Tab

Test Result: OK or Error

If a test is OK and you specified one run, the Test Result is **OK: 1 times**.

If a test has an error and you specified one run, the Test Result is **Error: 1 times**.

Saving

You can save any check result by checking the **Save error details** check box and specifying a destination file name.

Number of Runs Each Test

You can specify to run a test more than once.

Run All Tests Sequentially

This option runs all items in the Clock, Memory, Serdes, Crosspoint, Main FPGA, Expansion, and LED/Buzzer tests in order. After you check this check box, the command button becomes **Start All Tests**. You must click the **Stop Test** button on the LED/Buzzer tab to stop the check.

3.21.3 Memory Check

To perform a SDRAM or Exerciser RAM memory check, select the **Memory** tab.

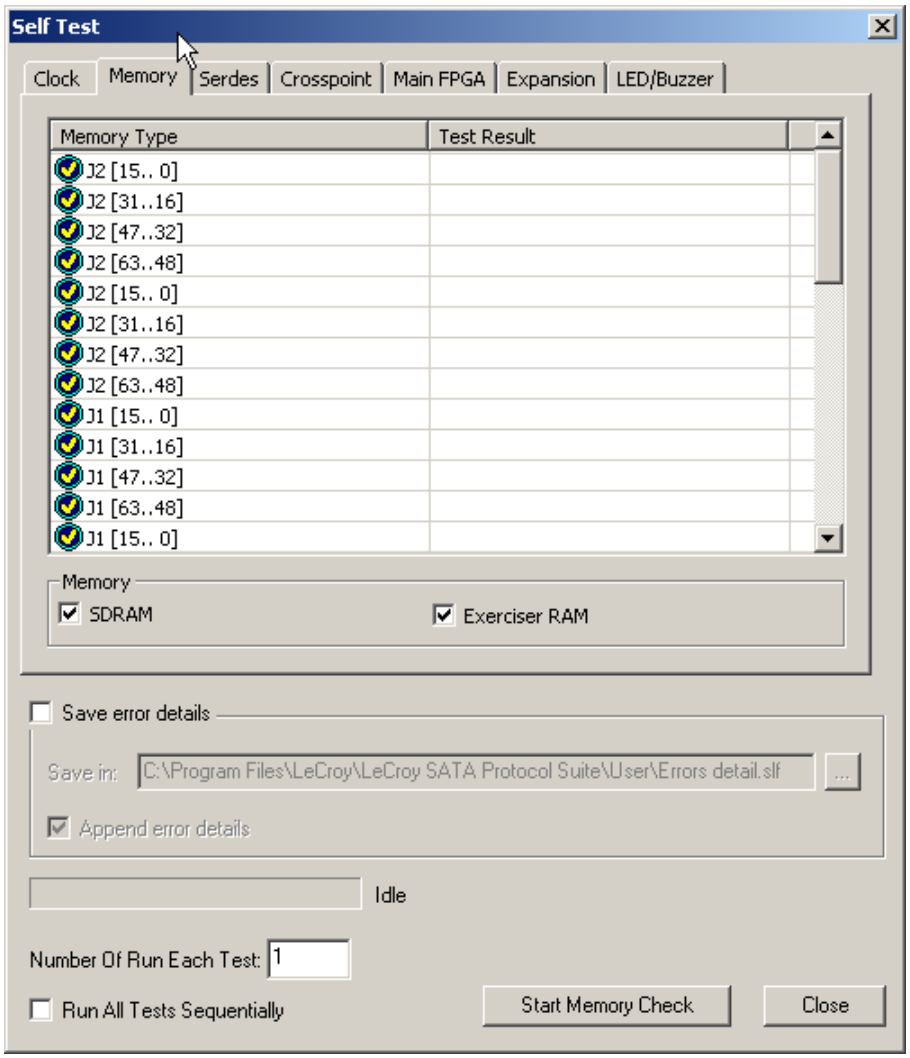


Figure 3.148: SAS: Self Test Dialog Memory Tab

Choose the SDRAM, Exerciser Data, or Exerciser Instruction to test and click the **Start Memory Check** button. After a short time, the Test Result appears to the right of the selected line.

3.21.4 Serdes Check

To perform an FPGA 1 or 2 Serdes Chip check, select the **Serdes** tab.

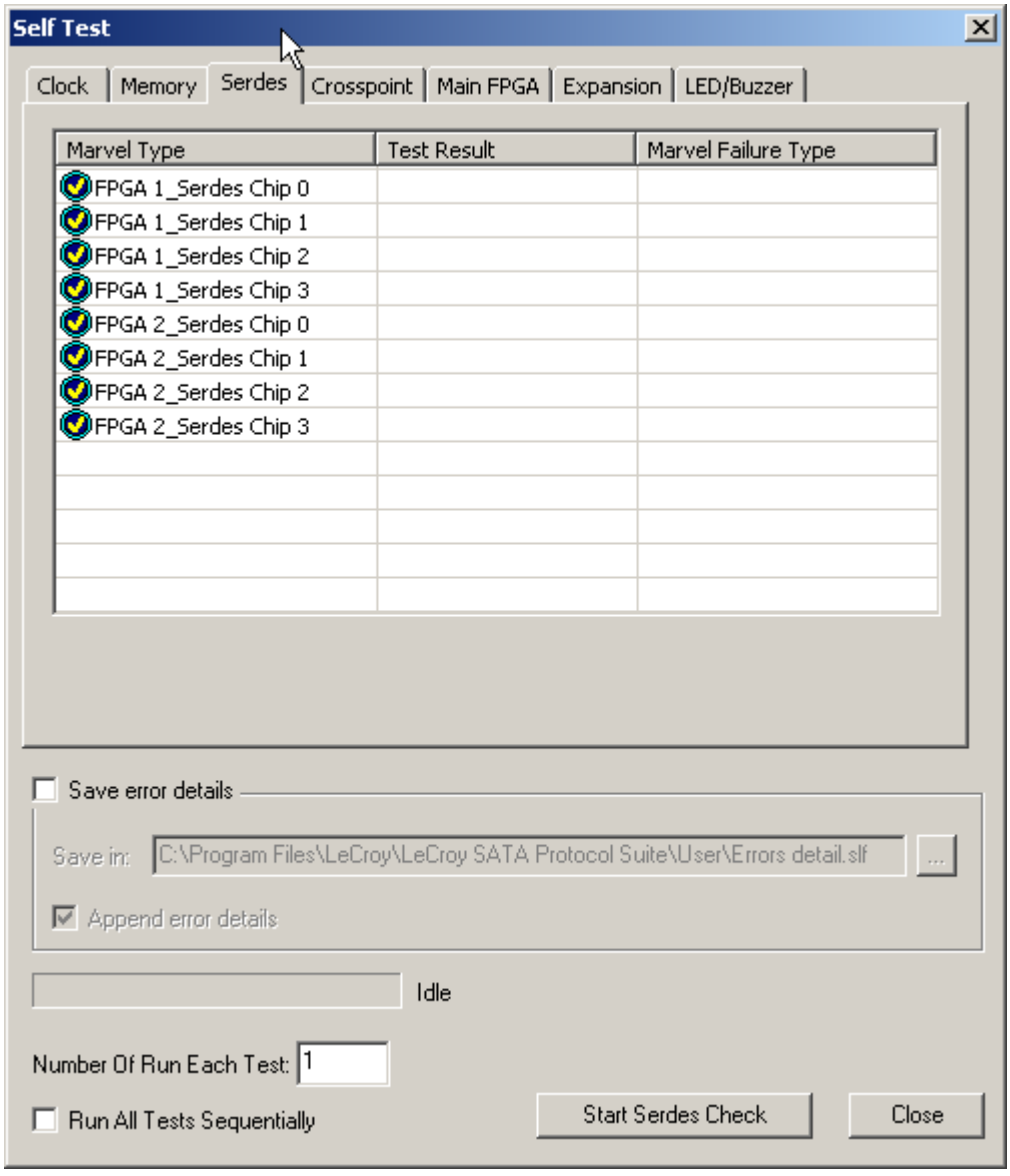


Figure 3.149: SATA: Self Test Dialog Serdes Tab

Choose the n FPGA 1 or 2 Serdes Chip to test and click the **Start Serdes Check** button. After a short time, the Test Result and Marvel Failure Type appear to the right of the selected line. Marvel Failure Type indicates the error type.

3.21.5 Crosspoint Check

To perform a Crosspoint-Crosspoint bus test or Crosspoint external loop back, select the **Crosspoint** tab.

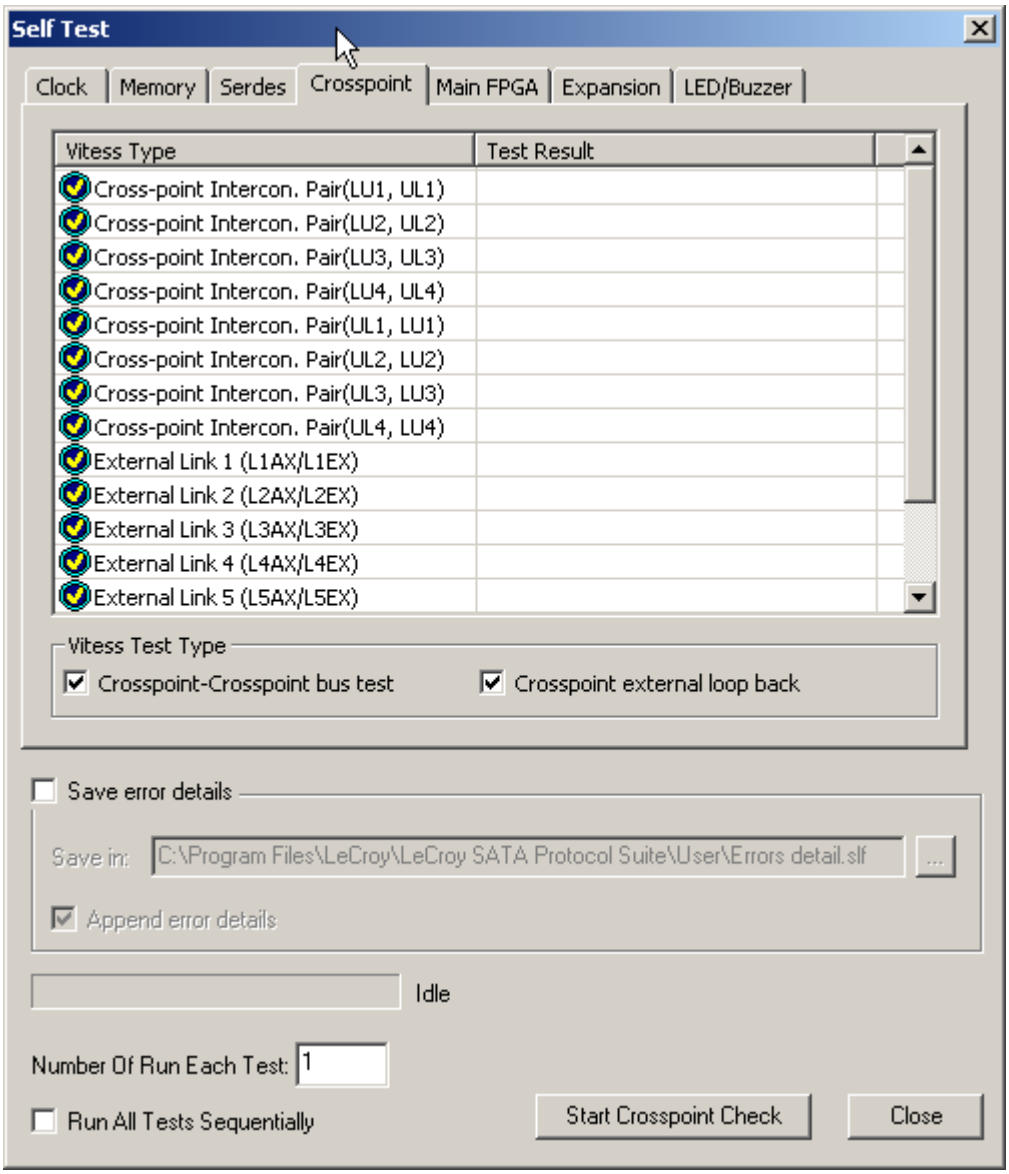


Figure 3.150: SATA: Self Test Dialog Crosspoint Tab

Choose the Crosspoint Interconnection Pair or External loop back to test and click the **Start Crosspoint Check** button. After a short time, the Test Result appears to the right of the selected line.

3.21.6 Main FPGA Check (SATA only)

To perform an Inter-FPGA Connection check, select the **Main FPGA** tab.

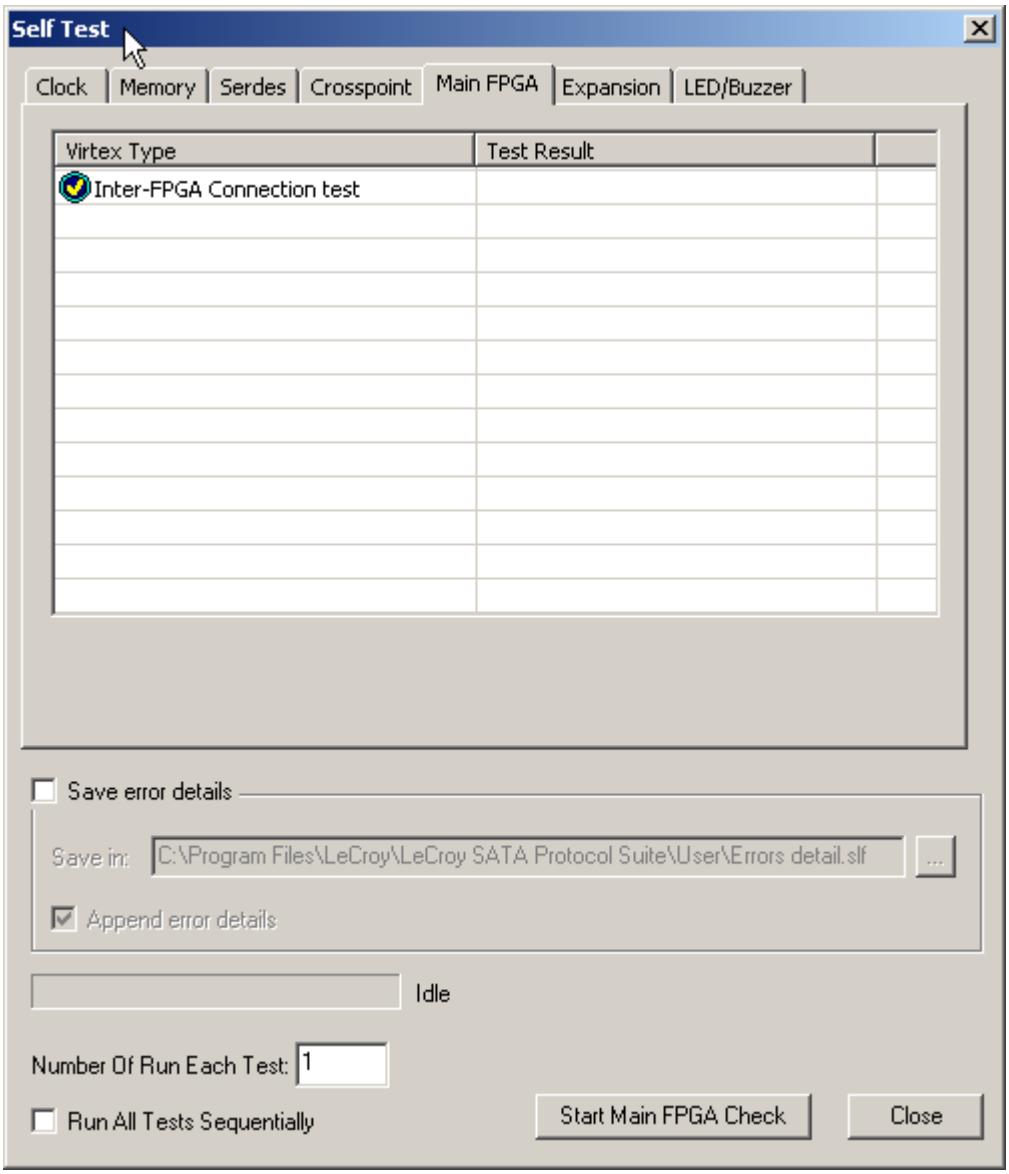


Figure 3.151: Self Test Dialog Main FPGA Tab

Choose the Inter-FPGA Connection test and click the **Start Main FPGA Check** button. After a short time, the Test Result appears to the right of the selected line.

3.21.7 Expansion Check

To perform a Expansion Card Data Status or Clock Status check, select the **Expansion** tab.

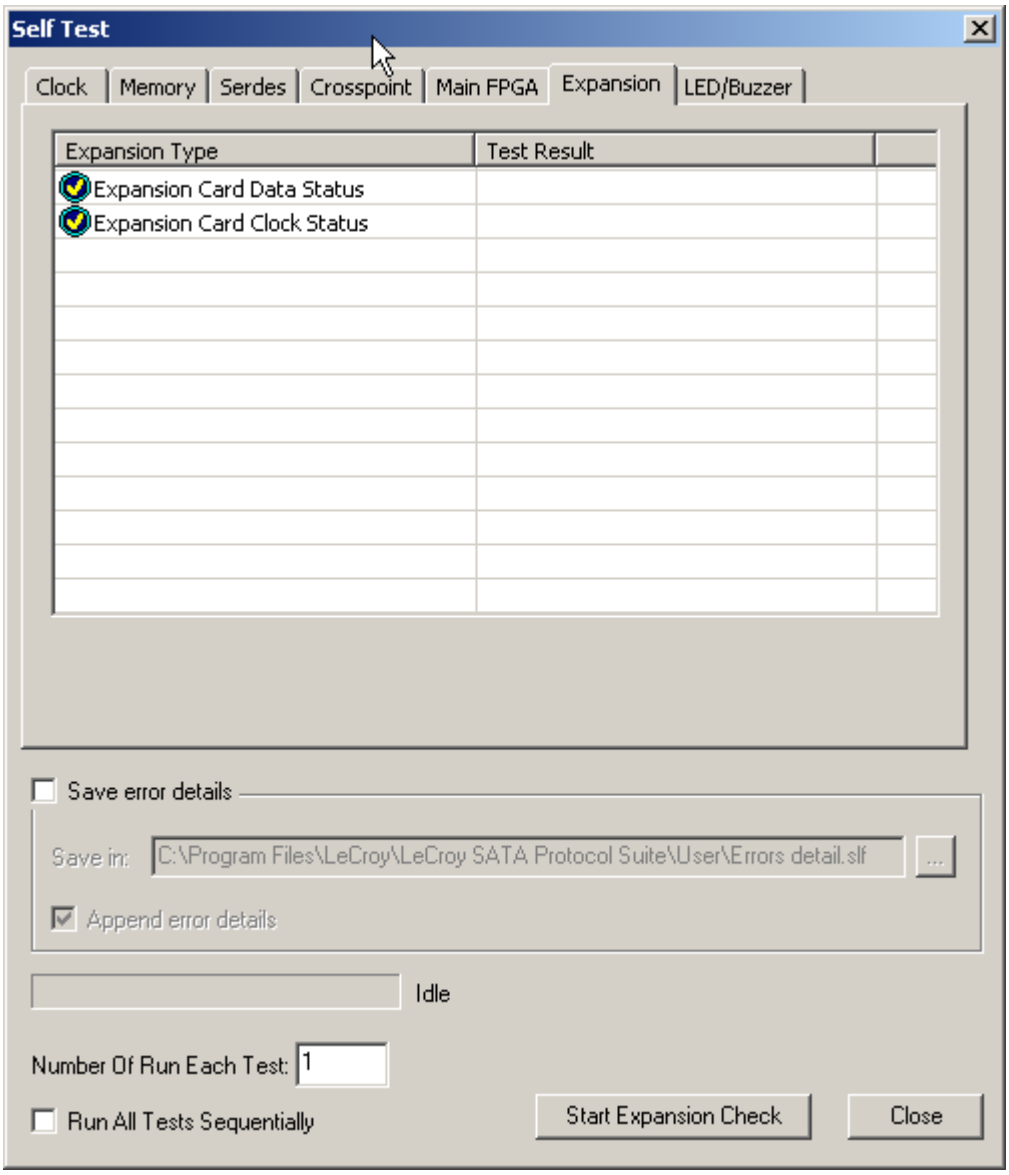


Figure 3.152: Self Test Dialog Expansion Tab

Choose the Expansion Card Data Status or Clock Status to test and click the **Start Expansion Check** button. After a short time, the Test Result appears to the right of the selected line.

3.21.8 LED/Buzzer Check

To perform a LED or Buzzer check, select the **LED/Buzzer** tab.

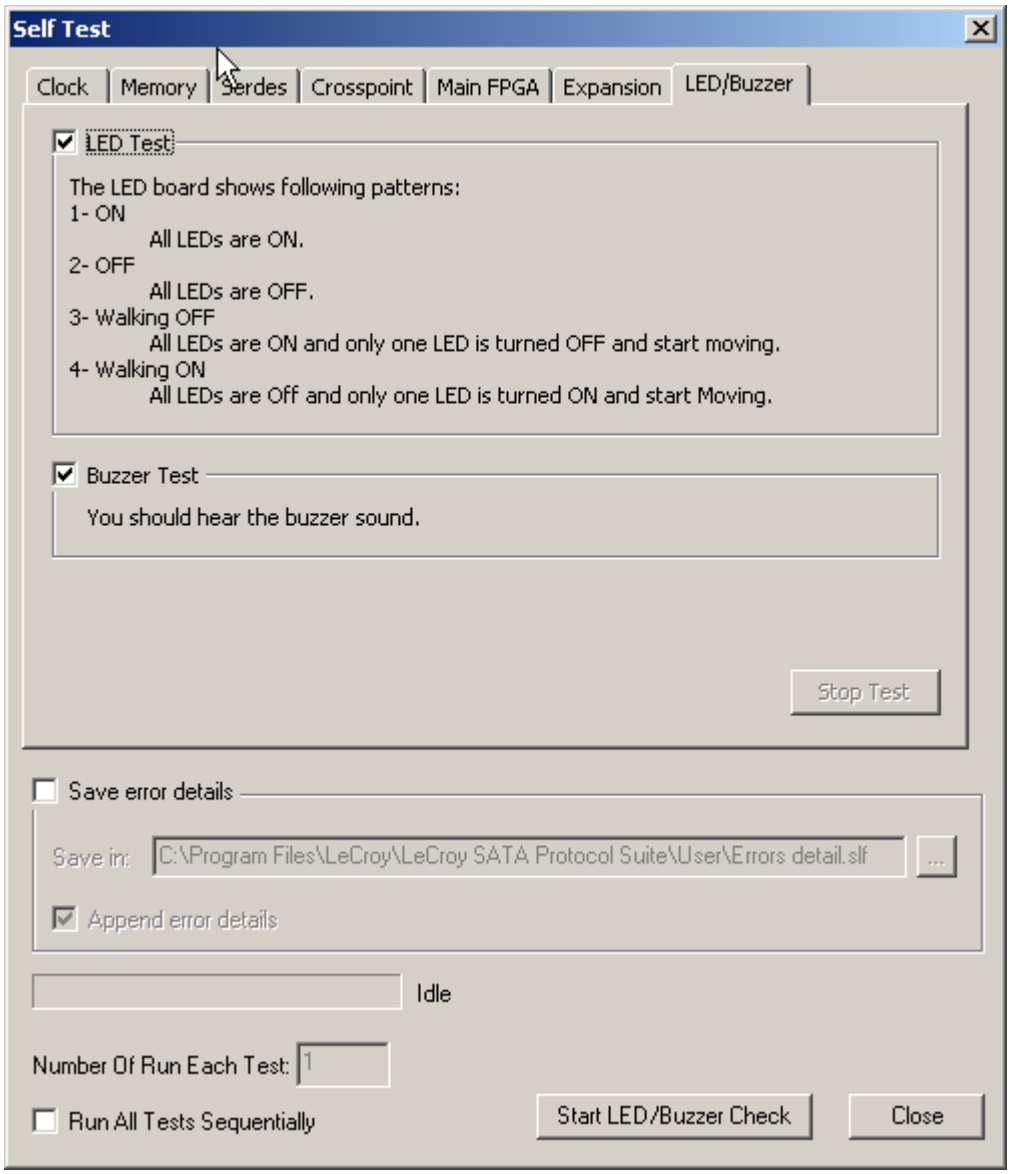


Figure 3.153: Self Test Dialog LED/Buzzer Tab

Check **LED Test** or **Buzzer Test** and click the **Start LED/Buzzer Check** button. For the LED, you should see the LED pattern. For the buzzer, you should hear it sound. You must click the **Stop Test** button to stop the check.

3.22 Find DUT

Saving device information allows you to import the specific device information into the Target/Device emulator.

The Find DUT utility obtains all vendor-specific information and detailed device parameters.

Find device finds any devices that are attached to any port.

Select **Setup** on the main menu bar and choose **Find DUT**.

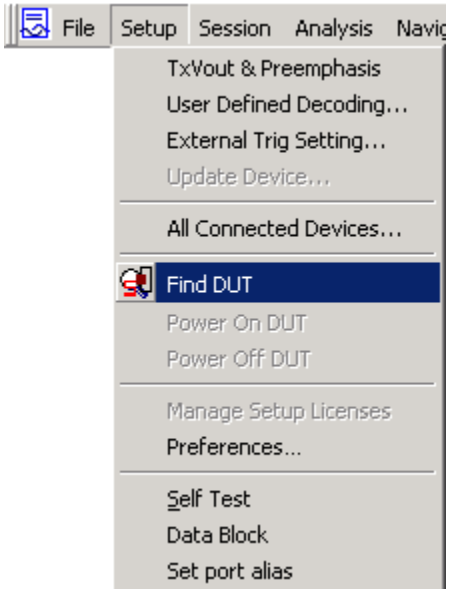


Figure 3.154: Find DUT

The Find DUT dialog opens. See following screen capture.

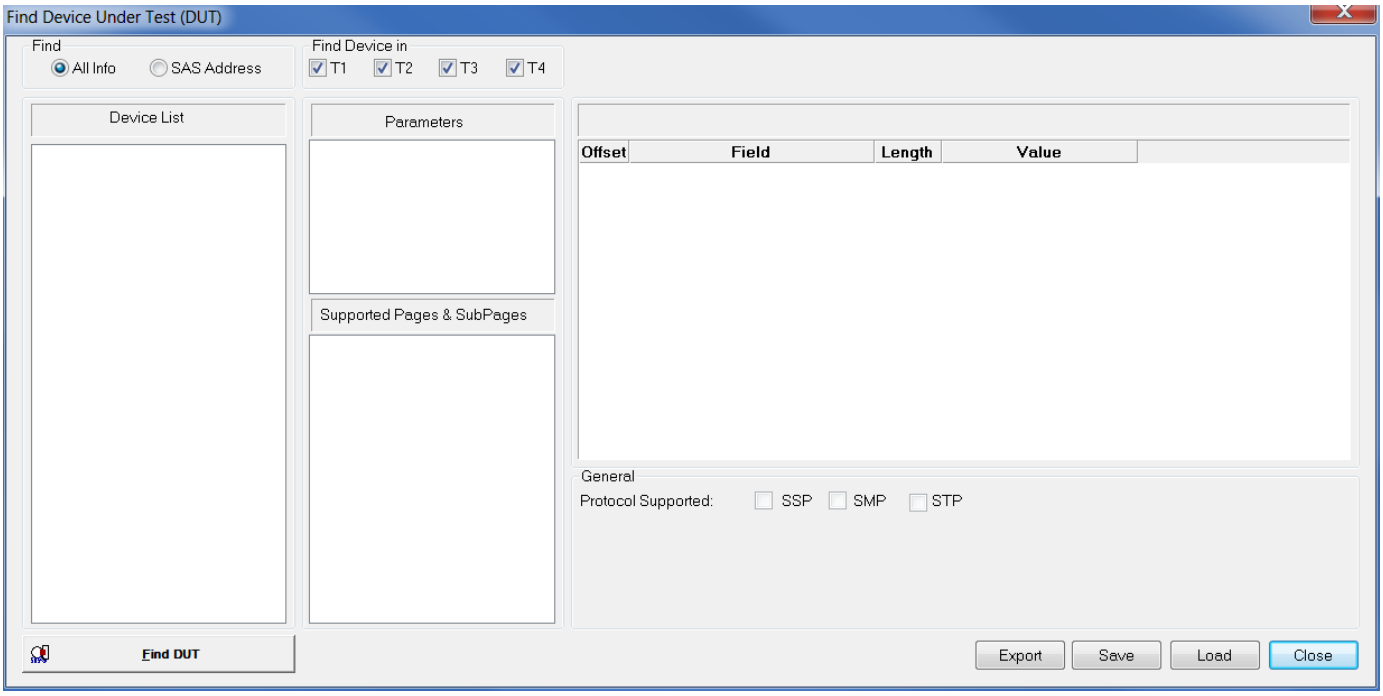


Figure 3.155: Find DUT Dialog

Click the **Find Device** button to search for connected devices. After a brief period, the dialog displays all device information.

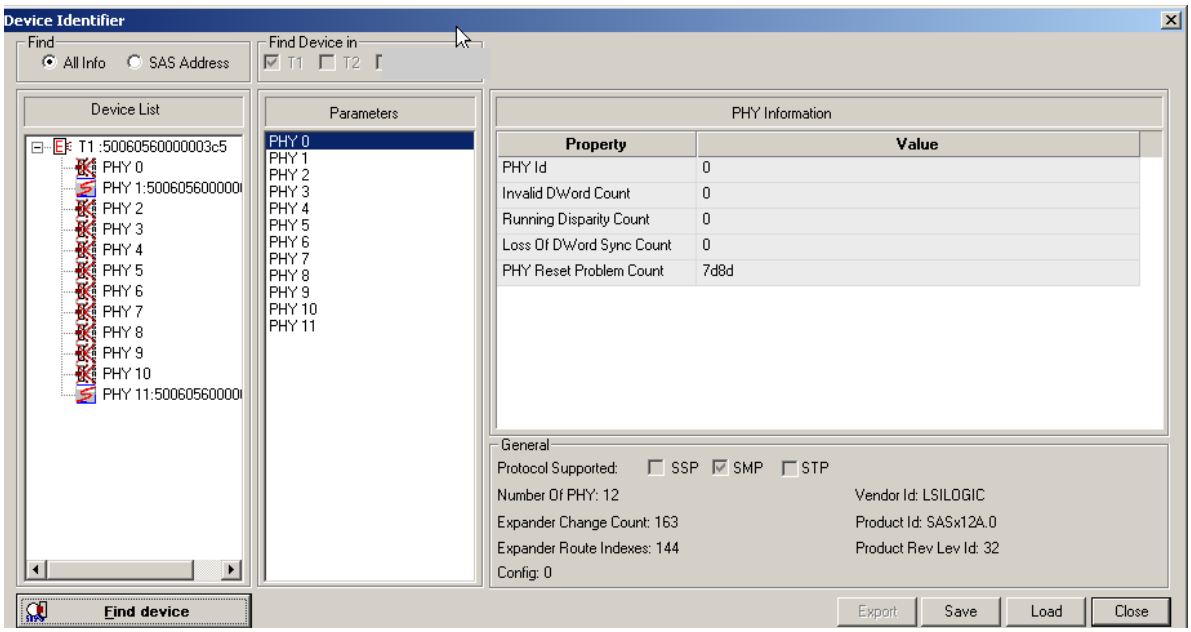


Figure 3.156: SAS: Identified Devices

Click a device in the Device List to display information about that device.

Aliasing

You can enter a 16-character alias name for a device. In the Device List, right-click the device name and enter an alias after the colon.

The alias name appears in the Device List.

Exporting

You can export a device specification to a text file. Click the **Export** button to open the Export dialog.

3.23 Power Source Control

This function allows you to manage power for connected devices.

Select **Setup** on the main menu bar and choose **Power Source Control**.

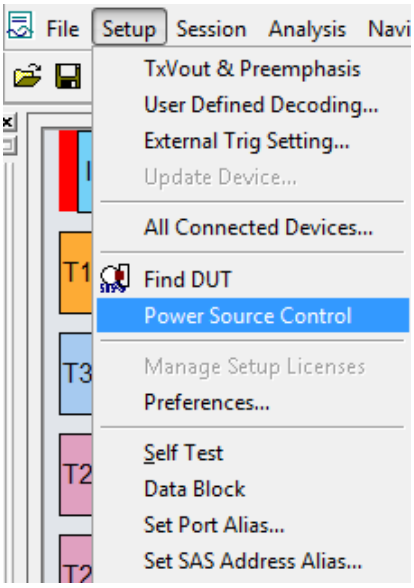


Figure 3.157: Power Source Control

The Power Source Control dialog displays (see Figure 3.158 on page 323).

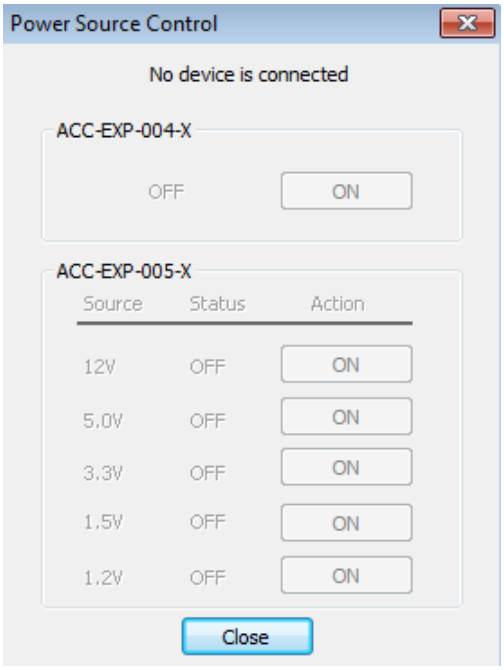


Figure 3.158: Power Source Control Dialog

3.24 Compliance Test (SATA)

The Compliance Test consists of a set of selectable tests to verify compliance with the SATA specification. SATA compliance is at UTD Rev 1.4.

Note: The tests follow the Teledyne LeCroy MOI, which is described in the **SATA_Digital-Device_MOI_LeCroy_1.00_UTD1.4.pdf** file in the installed Documents directory.

Note: You can start tests using the command line. The SAS/SATA Protocol Suite API Reference Manual, Section 2.12, starting on page 153, explains how to write VB scripts to automate compliance tests and generate results as RTF files.

To run a Compliance Test:

1. Click **Analysis** on the main toolbar and choose **Compliance Test** to open the Compliance Test dialog (see Figure 3.109 on page 280).

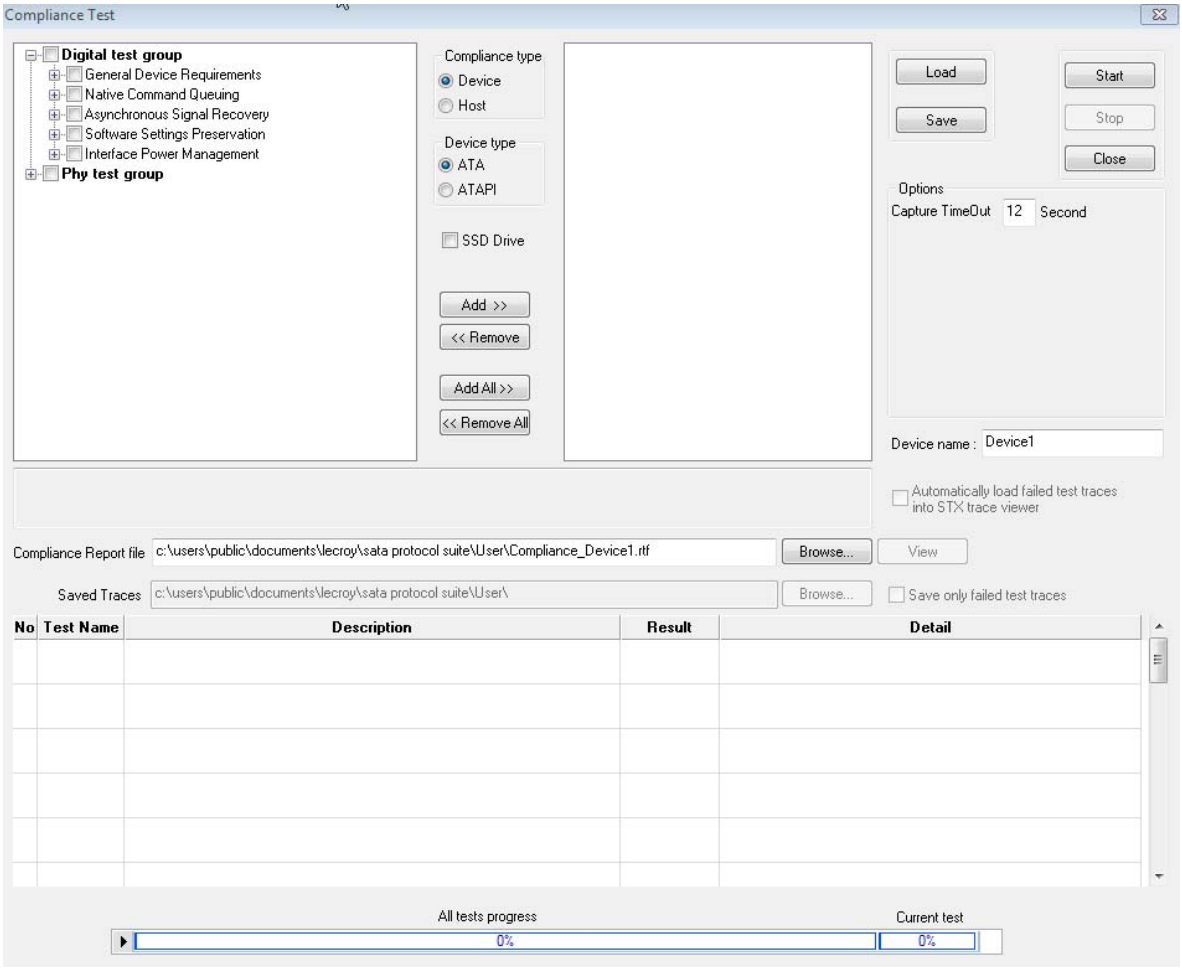


Figure 3.159: SATA: Compliance Test Selection

The Digital Test Group has:

- **General Device Requirements**: GTR-01 through GTR-05
- **Native Command Queuing**: NCQ-01 through NCQ-05
- **Asynchronous Signal Recovery**: ASR-01 and ASR-02
- **Software Settings Preservation**: SSP-01 through SSP-12
- **Interface Power Management**: IPM-01 through IPM-11
- **Digital Optional Features**: DOF-01 and DOF-02

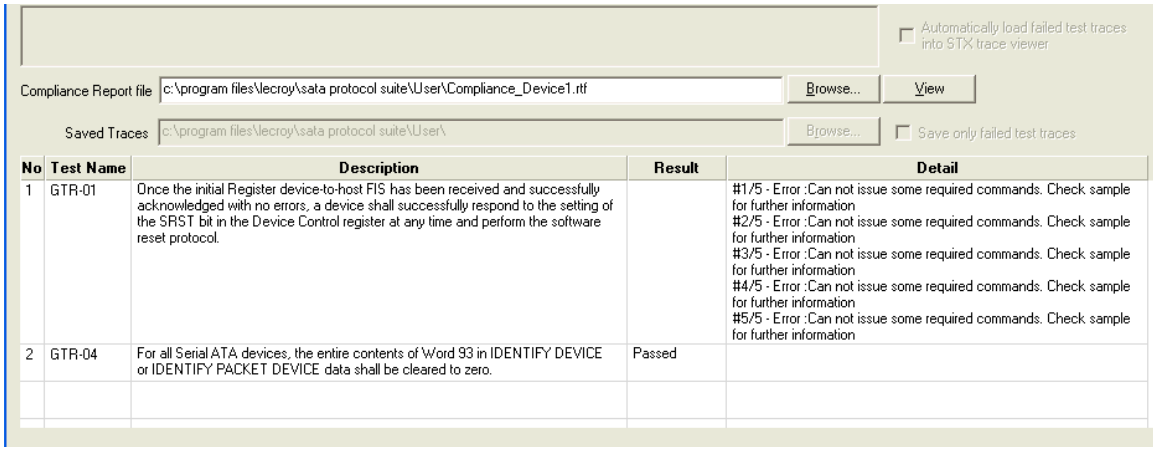
The PHY Test Group has tests OOB-03 through OOB-07.

2. Choose the tests in the left pane of the dialog and click the **Add>>** button.
3. Enter a value for **Capture Timeout**.

Note: If test running time exceeds the Capture Timeout value, the test terminates.

4. Enter the **Device Name**.
5. Select the UTD Version as **UTD 1.3** (for devices supporting up to SATA 2.6 specification) or **UTD 1.4** (for devices supporting up to SATA 3.0 specification).

6. Select the Compliance Type as **Host** or **Device**.
7. Select the Device Type as **ATA** or **ATAPI**.
8. When testing SSD devices, select the **SSD Drive** checkbox, to ensure correct test results.
9. To view failed test traces in the sample viewer, check the **Automatically load failed test traces into STX trace viewer** check box.
10. To save the failed test traces only, check the **Save only failed test traces** check box.
11. Enter a path and file name for the **Compliance Report file**, or use the default file name and path:
    C:\Program Files\LeCroy\SATA Protocol Suite\User\Compliance_Device1.rtf
12. Enter a path and file name for the **Saved Traces**, or use the default folder:
    C:\Program Files\LeCroy\SATA Protocol Suite\User\
13. After you select tests, click **Start**.
14. The test runs and, after a brief period, displays the result.



No	Test Name	Description	Result	Detail
1	GTR-01	Once the initial Register device-to-host FIS has been received and successfully acknowledged with no errors, a device shall successfully respond to the setting of the SRST bit in the Device Control register at any time and perform the software reset protocol.		#1/5 - Error :Can not issue some required commands. Check sample for further information #2/5 - Error :Can not issue some required commands. Check sample for further information #3/5 - Error :Can not issue some required commands. Check sample for further information #4/5 - Error :Can not issue some required commands. Check sample for further information #5/5 - Error :Can not issue some required commands. Check sample for further information
2	GTR-04	For all Serial ATA devices, the entire contents of Word 93 in IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data shall be cleared to zero.	Passed	

Figure 3.160: Compliance Test Result

15. To save the current compliance setup for later use, click the **Save** button to open the Save As dialog. Assign a meaningful name to the setup and save it as a ***.cst** compliance file.
16. To run a previously defined setup, click the **Load** button and choose a previously defined setup to run.

Note: When you are running Compliance Test, do not connect the analyzer to the Host if testing a Device. Do not connect the analyzer to the Device if testing Host. Such improper connections can impact compliance-test result validity.

Chapter 4

InFusion Overview

The Teledyne LeCroy InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool that allows you to verify real-world fault handling for Serial Attached SCSI (SAS) and Serial ATA (SATA) systems. InFusion can sit unobtrusively in the data path on a live system to programmatically alter or corrupt traffic. InFusion is the ideal tool for stress-testing systems using actual workloads.

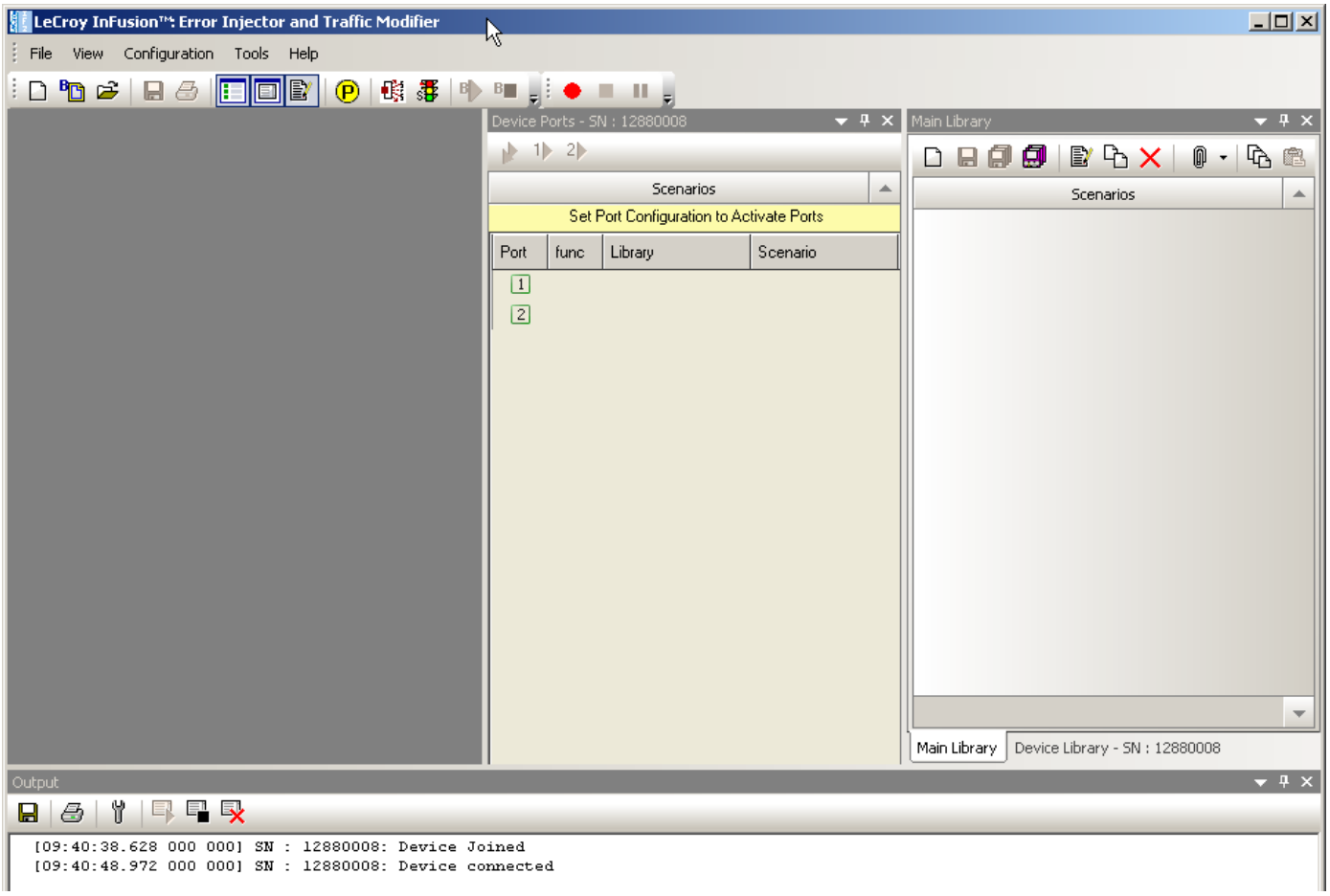


Figure 4.1: InFusion Windows

InFusion supports SAS SSP, SMP, STP, and SATA-based protocols operating across a single SAS or SATA link up to 6 G. InFusion monitors traffic from both directions in real-time and relies on predefined rules to replace any bit, primitive, or parameter with one you specify. InFusion can change traffic when it detects a specific sequence or reaches a designated time interval, yet it requires no complicated scripts, programming, or simulation tools.

InFusion can monitor traffic in both directions and act on events occurring in either direction of the communications link. InFusion can modify traffic in only one direction within a given test scenario, but that direction can be either from the Initiator or from the Target.

InFusion is specifically designed to verify recovery characteristics within a subsystem. An easy pop-up menu interface allows you to create specific test scenarios in just minutes.

Once a InFusion session starts, the system automatically handles protocol handshaking between devices. InFusion transmits a faithful copy of the original data stream down to the CRC value which, if needed, it recalculates. InFusion allows test engineers to systematically verify error recovery in ways not possible with other test platforms.

An Infusion event can trigger an analyzer.

Infusion supports all commands in the SATA 3.0 specification.

4.1 Key Features

The key features of InFusion are:

- **Error Injection**: Injects CRC, disparity, 8b/10b encoding, framing, and coding errors.
- **Break Link Recovery**: Programmatically breaks the connection to test link recovery.
- **Value Replacement**: Monitors the link for specific values, patterns, or primitives (as low as bit level) and replace with user-defined values. You can replace values on every occurrence, after a specified number of occurrences, or after a specified time interval.
- **Packet Drop**: Removes individual primitives, address frames, or data frames from the stream to verify retry behavior.
- **Primitive Manipulation**: Replaces handshaking and flow control primitives to help validate robustness of a design.
- **Traffic Monitoring:** Operates as a traffic monitor, collecting statistical data on user-specified parameters. In this mode, data passes unchanged in both directions.
- **Menu-Driven Interface:** Allows easy set-up of test scenarios.
- **API based on C++:** Allows development of custom test applications.
- **Scenario Batch Files:** Allows scenario scripts.

With respect to traffic modification, in the Link Layer you can modify primitives, CRC, scrambled traffic, and SSP, SMP, and STP connection events. You cannot modify clock skew management, OOB and power management, and signal integrity.

InFusion consists of a hardware device that connects to the line under test and a Windows-based software application used to create and download test scripts to the device. You also can use the software application to configure and control the device across an Ethernet link.

InFusion test scripts are called scenarios. Scenarios determine how the hardware device monitors and modifies line traffic. You must use the application to create and download scenarios.

For the InFusion connections, the device is connected between the SAS/SATA host and the PHY of the test target (DUT). While jamming, the signals between ports I1 and T1 (for example) are routed through the FPGA, as opposed to being routed through the front end in the case of Analyzer mode. Both Out of Band (OOB) and data signals propagate through the FPGA.

4.2 Interface

4.2.1 Buttons

The InFusion interface has the following command buttons:

New Scenario: Begins the scenario creation process by listing Scenario Name, Direction for traffic changes, and Global Rules in the scenario window.

New Batch Script: Starts a scenario batch file in Batch Script window.

Open Library: Lists the InFusion Library Files (**.infdb**), which contain the available scenarios, in an Open dialog.

Save: Saves the current scenario in the UserData folder.

Print: Prints the current scenario.

Show Library: Displays/hides the Main Library window (on the right), which displays the available scenarios. You can create a new scenario, save a selected scenario, save the library, save a copy of the library, display the selected scenario, insert a copy of the selected item, or delete the selected scenario.

Show Output: Displays/hides the Output window (at the bottom), which displays InFusion output. Use the buttons to save output, print output, display options (automatically save the log file, with a path and size), start logging, stop logging, and clear the Output window.

Show Port Assignment: Displays/hides the port assignment.

Port Configuration: Displays the port configuration dialog. See “Port Configuration for InFusion” on page 333.

Launch Analyzer: Returns to the Protocol Analyzer or Target/Host Emulator window.

Launch Trainer: Goes to the Trainer window.

Run Batch Script: Runs a scenario batch file.

Stop Batch Script: Stops a running scenario batch file.

Record: Starts recording on the current analyzer, using the current project.

Stop: Stops recording on the current analyzer.

Abort: Aborts recording.

4.2.2 Menus

The InFusion interface has the following menus:

File

(see command descriptions in the “Buttons” section above)

- New Scenario, Open Scenario (File Library or Main Library)
- Open an InFusion database (.**infdb** file)
- Launch Analyzer
- Launch Trainer
- New Batch Script, Save Batch Script As
- New Library, Close Library (File Library or Main Library), Save Library, Save Copy of Library As
- Open Log File
- Print Setup
- Recent Trace Files
- Recent Project Files
- Close

Setup

- External Trig Setting (see “External Trig Setting” on page 306)
- Update Device (see “Update Device” on page 307)
- All Connected Devices
- Status Bar

View

- Views (Library, Output, Port Assignment, Customize - commands, Toolbars, Keyboard, Menu and Options)
- Smart Docking
- Toolbar
- Status Bar

Configuration

- Port Configuration (see “Port Configuration for InFusion” on page 333)
- Batch Script Setting (see “Scenario Batch Files” on page 377)

Tools

Browse UserData, System, or InFusion folder.

Help

Help Topics and About InFusion.

4.2.3 Main Library

You can **Show Main Library**.

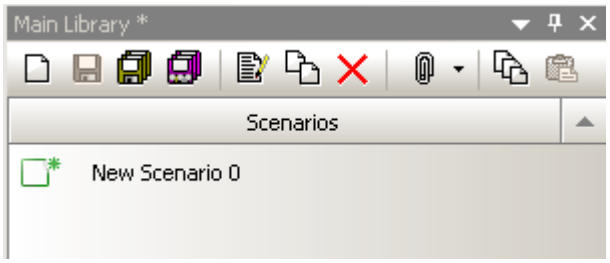


Figure 4.2: Main Library

The Main Library has Scenarios.

Using the buttons from left to right, you can:

- Create a new scenario and save a scenario.
- Save a library and save a copy of a library.
- View/edit a scenario, insert copy of a scenario and delete scenario.
- Copy and paste.

4.2.4 File Library

You can display the File Library.

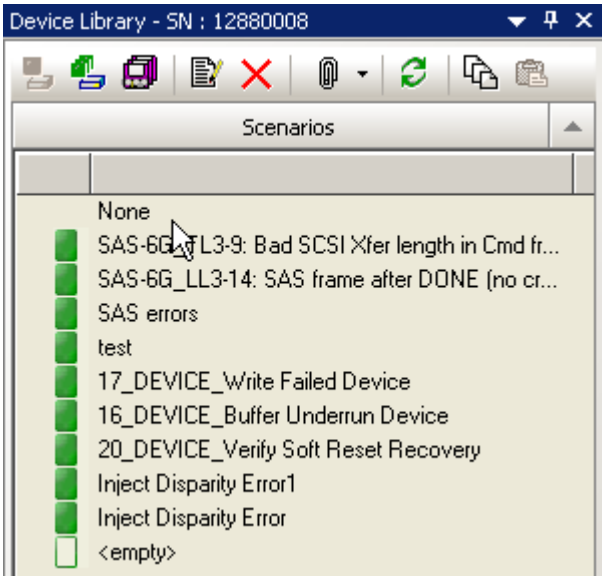


Figure 4.3: File Library

A File Library has Scenarios currently available in the device.

Using the buttons from left to right, you can:

- New scenario.
- Save selected scenario.
- Save library.
- Save a copy of the library as.
- View/edit a selected item.
- Insert a copy.
- Delete a selected scenario.
- Copy
- Paste

4.2.5 Device Ports

If a device is connected, the software displays the Device Ports.

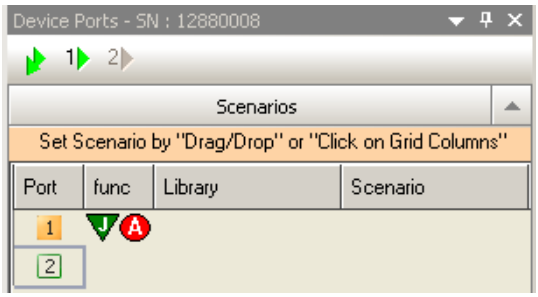


Figure 4.4: Device Ports

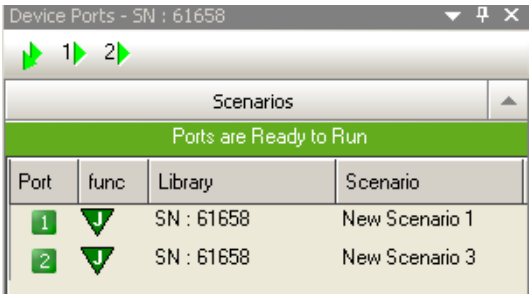
Using the first row of icons, you can Run/Stop All Ports or Run/Stop individual ports. The columns display the Port, Function/Configuration, Library, and Scenario. You can Float, Dock, Auto-Hide, or Hide the window.

Note: A port row is grayed-out when that port has not been configured to be a Jammer in the Port Configuration dialog (see “Port Configuration for InFusion” on page 333).

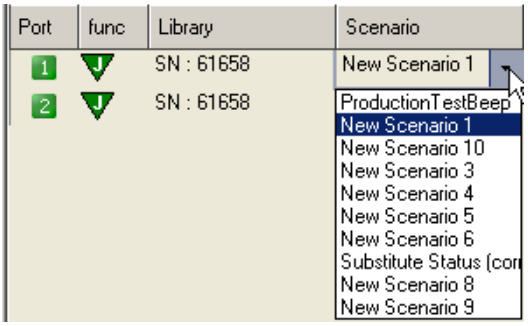
Using the Device Ports Dialog

After you have finished Port Configuration (see “Port Configuration for InFusion” on page 333), you use the Device Ports dialog to assign specific scenarios to ports, so that different scenarios can run on different ports.

To assign a scenario to a port, drag and drop the scenario from any library window to the port. The Device Ports dialog then displays the Library and Scenario on the row for that Port/Configuration.



Alternatively, assign the scenario using the Library and Scenario drop-down lists.



After you have assigned scenarios to ports, in the first row of icons, use the first green arrow icon to **Run/Stop All Ports**, or use the numbered green arrows to **Run/Stop an individual port**.

Note: A port row is grayed-out when that port is running a scenario.

4.3 Port Configuration for InFusion

The InFusion (Jammer) port configurations must match the Analyzer port configurations for the infusion-analyzer to work.

Select **Configuration > Port Configuration** to display the Set Port Configuration dialog.

To record traffic, select **Jammer** on the port that you want to jam. In the following figure, there is a match on Port 1.

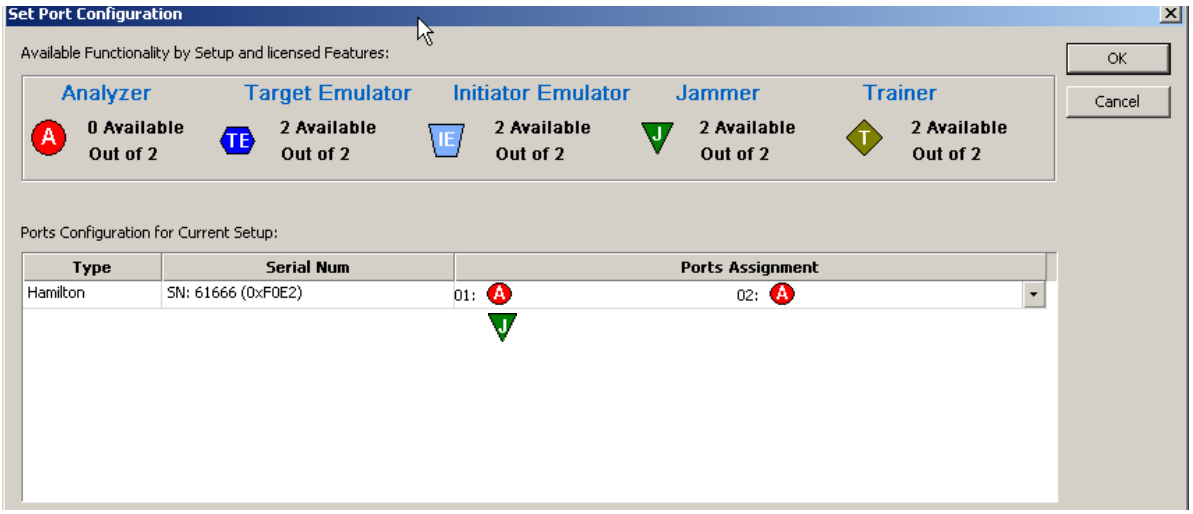


Figure 4.5: Ports Configuration Dialog with InFusion/Analyzer Port Match

You can select only one Jammer port at a time with this configuration.

Note: To display the current Port Configuration, click **Show Analyzer** to go to the analyzer application, then click the green button in the lower right corner to display the Port Status window (see "Port Status" on page 284).

Important Information for Jammer and Analyzer

Jammer intercepts and delays traffic on both directions simultaneously, so Host sends to Jammer, Jammer delays and sends to Host, Device sends to Jammer, Jammer delays and sends to Device. However, Jammer modifies traffic in one direction only: from Host to Device, or from Device to Host.

When using Jammer and Analyzer, the Select Port Configuration dialog has options JA as shown in Figure 4.6.

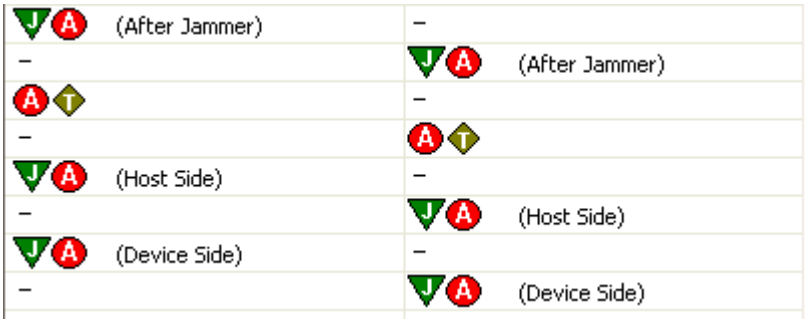


Figure 4.6: Select Port Configuration Options with Jammer and Analyzer

The following figures illustrate the available setup options.

- **JA (After Jammer)**: Analyzer captures Jammer to Host and Jammer to Device. Analyzer is after Jammer on both paths. See Figure 4.7: .

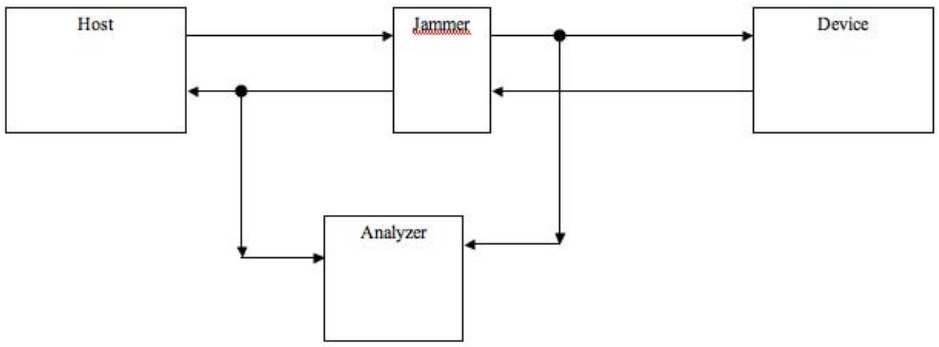


Figure 4.7: Jammer and Analyzer with Analyzer after Jammer

- **JA (Host Side)**: Analyzer captures Host to Jammer and Jammer to Host. Analyzer is before and after Jammer on Host side. See Figure 4.8.

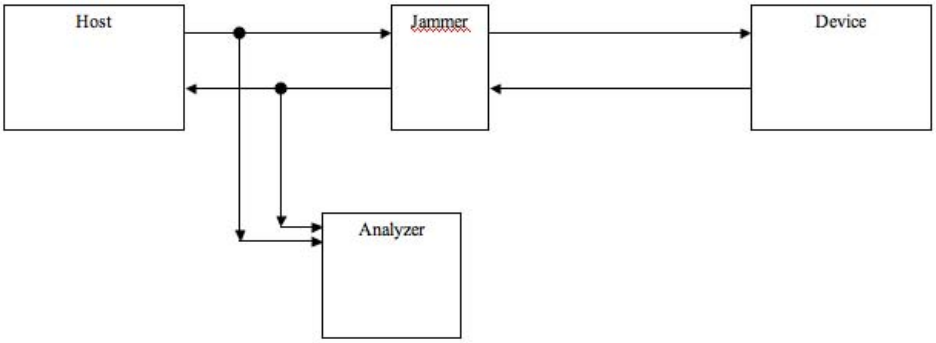


Figure 4.8: Jammer and Analyzer Host Side

- **JA (Device Side)**: Analyzer captures Jammer to Device and Device to Jammer. Analyzer is before and after Jammer on Device side. See Figure 4.9.

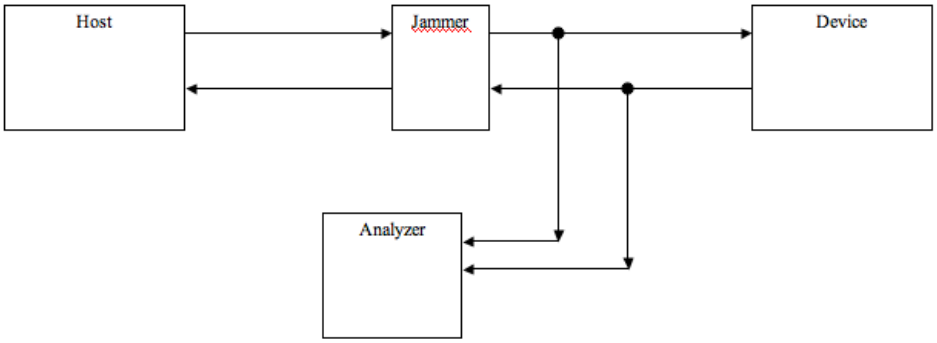


Figure 4.9: Jammer and Analyzer Device Side

The setup options are the same whether Jammer modifies traffic from Host to Device or from Device to Host.

Note: When the Unit Under Test (UUT) is the Host, using JA (Host Side) (see Figure 4.8) will give the most accurate recordings of Host behavior, though the Jammer delays will accumulate in the round trip.

Note: When the Unit Under Test (UUT) is the Device, using JA (Device Side) (see Figure 4.9) will give the most accurate recordings of Device behavior, though the Jammer delays will accumulate in the round trip.

Note: The After Jammer configuration (see Figure 4.7) is useful when debugging a system, as the tapping points are balanced to account for Jammer delays. Note that when SATA traffic is recorded, this configuration might show out of order HOLD/HOLDA primitives, due to the special handling of these primitives by the Jammer.

Note: When running InFusion in an AJ port configuration a "FIS Signalling Latency Error" message displays due to the delay through the InFusion Jammer. This can prevented by turning off the detection of this error using the Protocol Error Mask dialog from the Settings tab.

4.4 InFusion Scenarios

You can create and execute InFusion scenarios. A scenario is a test script that defines how InFusion monitors and modifies line traffic.

4.4.1 Scenarios Overview

You create scenarios on a host machine running the InFusion application. You then assign the scenarios for execution to a desired port on an InFusion device. You can also download up to ten scenarios to each InFusion device.

The InFusion application provides a menu-driven interface for building scenarios. The interface prompts you for simple decisions and choices from drop-down menus. As you make your selections, the script takes shape automatically in the scenario window. The script is in the form of simple English sentences. You need not understand any formal scripting language.

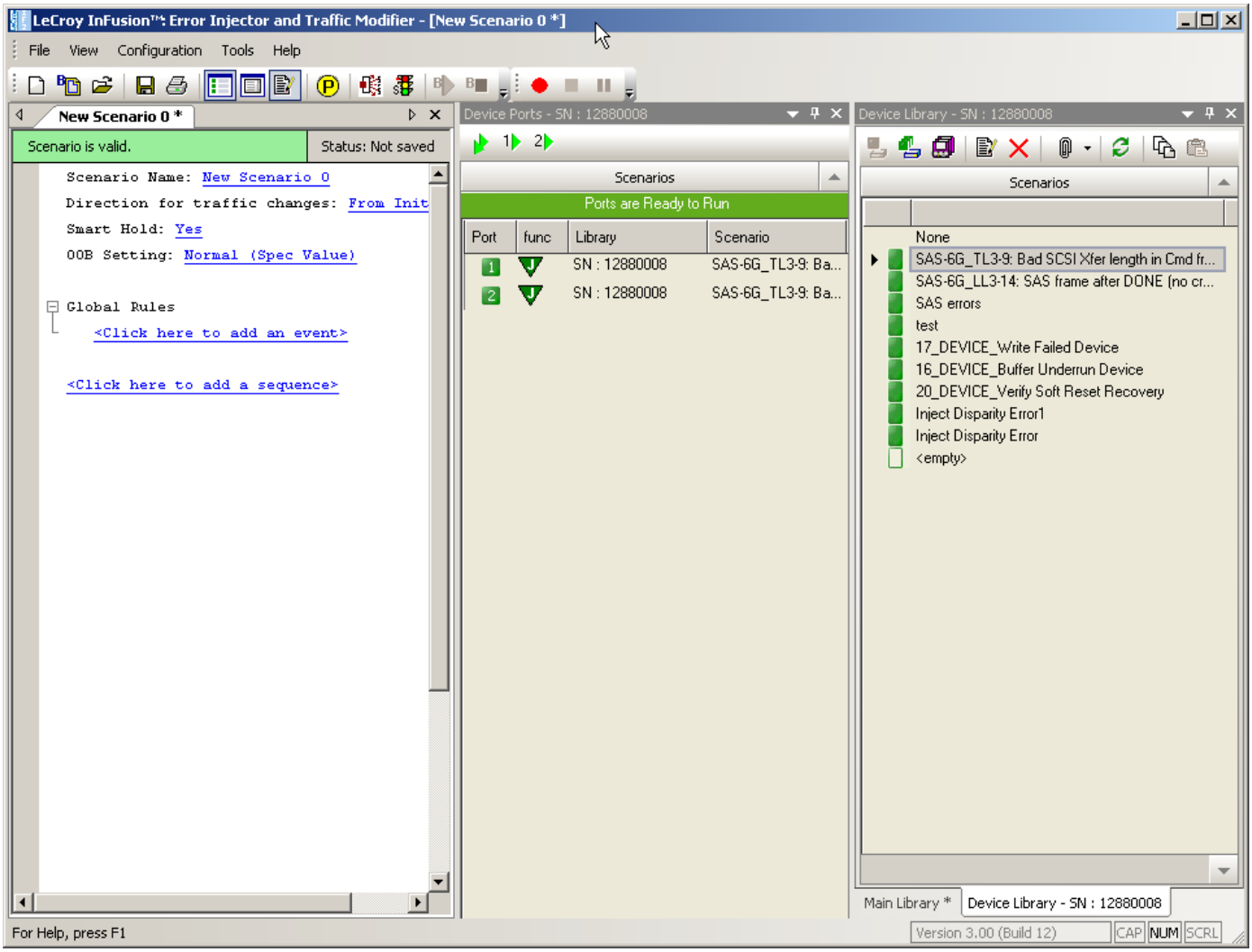


Figure 4.10: New Scenario in InFusion Window

InFusion Scenario Parameters

Timers

Timers allowed per state/sequence/scenario:

2 timers per state and 6 timers per scenario are allowed.

Events

Events allowed to be used per state/sequence/scenario:

For combined events, there is virtually no limit per state/sequence/scenario.

Actions

Actions allowed per state/sequence/scenario:

A maximum of 8 actions per state, 2048 actions per sequence (8*256 state), 4104 actions per scenario (2*2048 + 8 more in the Global Rules "state").

Monitors

Monitors allowed to be used per state/sequence/scenario:

InFusion can keep an account of 8/12 Monitor/Count events per scenario.

Random change of use of count and count randomly:

In Global Rules, if a Counter is used for Event counting, 2 extra actions are consumed. 2 more actions are required for "Every Nth occurrence" option.

In Sequences, If a Counter is used for Event counting, 3 extra actions are consumed. 3 more actions are required for "Every Nth occurrence" option.

Regarding limits on any of the above mentioned connections, i.e., x timers + y monitors are allowed per state where x+y=n:

There are a lot of big/small rules checked by the scenario compiler, but as a rule of thumb:

8 actions per state are available

12 counters globally are available, each assigned permanently to a certain job

6 available timers per scenario

12 programmable multi-purpose resources for DWORD comparison/substitution/capture are available. If a pattern detector uses 3 of these resources to trigger on a specific frame on the bus, only 9 more resources are available for other tasks. Frame/FIS type detectors are excluded from this rule, because they use their own dedicated resources.

8 primitive detectors are available

If you want to trigger on a pattern (Frame/FIS) and change/capture a dword(s) before the last offset of a detected pattern (e.g., changing the Frame Type of a SAS Frame with Data Offset == 11223344), you are limited to a maximum of 9 dword offset (i.e., if you trigger

on the 20th payload of a Data FIS, you can change/capture the 12th dword onwards. 11th payload dword and preceding dwords are not accessible for change/capture)

You can not change a state based on back-to-back events. At 6G speed, there should be at least one dword between the triggering event of two consecutive states. At other speeds, back-to-back dword state transitions might rarely be missed, so best practice is to never assume back-to-back dword events.

As described later in this chapter, you can create any number of scenarios and store them in libraries on the host machine's hard drive. Scenario library files names are in the following format:

`<filename>.infdb`

Creating InFusion scenarios is easy, but it requires an understanding of the following terms defined in Table 1.

TABLE 4.2: Key Scenario Terms

Term	Definition
Action	InFusion response to an event.
Event	Condition that is detectable by InFusion.
Combined Event	Logical OR association of events (for example, event A OR event B).
Global Rules	Portion of a scenario that can define a single InFusion test state. You can think of the Global Rules and each sequence as a separate test routine or program operating within the scenario. Each operates independently and in parallel with the others. The purpose of each is to detect events and then respond with the appropriate action or set of actions. In essence, you can operate up to three test states simultaneously within InFusion.
Sequence	Portion of a scenario that can define multiple InFusion test states. More flexible than the Global Rules, a sequence allows more powerful scenarios that include branching and looping between test states (Global Rules can define only a single test state, so there is no branching).
State	"Behavior" of the Global Rules or a sequence at any point in time. In terms of InFusion testing, behavior is "waiting" for a set of events and responding with a set of actions.

4.4.2 Global Rules

Global Rules are a portion of the scenario that can define only one test state. To create the Global Rules, you use the menu-driven interface to enter an event or combined event and the corresponding action or set of actions (the response of InFusion hardware to the event).

In the case of a combined event, the action is taken upon occurrence of any of the events stated for the event combination. It is a logical OR association, meaning any of the events can trigger the action.

After you enter the event or combined event, the interface prompts you for actions. An action might be, for example, injecting a particular primitive or error into the traffic stream. You can enter multiple actions, which take place simultaneously.

After defining the event and actions within the Global Rule area, you can save the scenario and download it to a InFusion device.

Sequences

The Global Rules are all you need for simple test scenarios. However, a scenario also can contain one or two sequences, which can define multiple states and allow branching between states. With a sequence, you also can do looping, which allows you to repeat a test state or to execute a test for a specified period of time.

As with Global Rules, the menu-driven interface guides you in building a sequence. Some of the prompts are different, however, because you now are encapsulating groups of events and actions as distinct states. Recall that a state is a combination of events and actions at a specific point in time. If the event or combined event defined by a state occurs, the corresponding action or set of actions follows.

Figure 4.11: Global Rules and Sequence Areas of a Scenario

InFusion hardware provides the capacity to have up to two sequences co-existing in a scenario in addition to the Global Rules. Recall that both the Global Rules and any sequences are active at all times. Each is a separate “state machine,” having the behavior of a particular test state at any point in time. Because the Global Rules has the capacity for only one state, you can view it as a “degenerative state machine.”

4.5 Scenario Libraries

You can create any number of scenarios, which you then can archive on your host machine's hard drive. You also can download up to ten scenarios to each InFusion device for test execution. You can think of the libraries as windows that hold scenarios.

Recall that each library is a separate ***.infdb** file.

4.5.1 Main Library

When you launch the InFusion application, it opens a window called the Main Library. The main library is the default workspace for creating and storing new scenarios. The main library corresponds with the following file in the InFusion folder on the host machine's hard drive:

```
default.infdb
```

4.5.2 File Libraries

You can save the main library with a name other than default (while still using the **.infdb** file extension). The new file becomes a file library that is functionally equivalent to the main library with the following exception: It does not open by default in the Main Library window. You can navigate to other file libraries using the File Manager of the InFusion application.

In this manual, the main library and other **.infdb** file libraries are collectively called general libraries.

If you select **Open Library,** you see a window similar to the following:

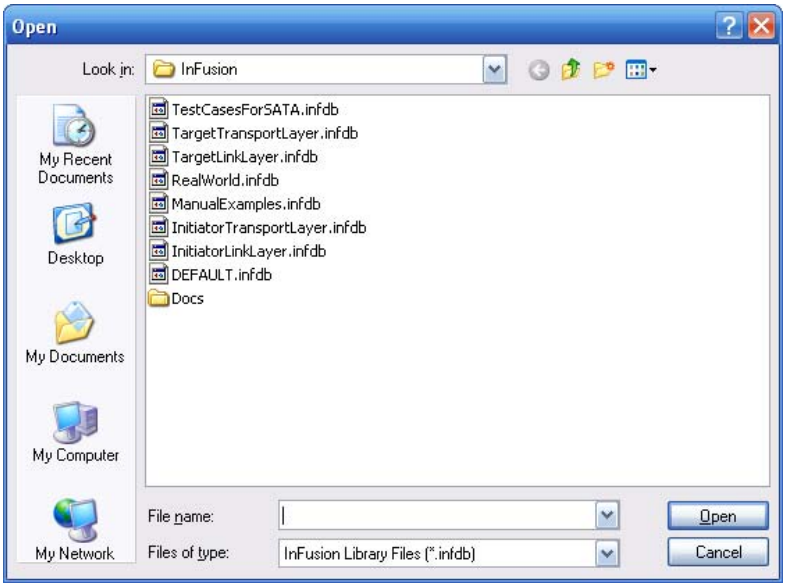


Figure 4.12: Open Library File List

By selecting the **TestCasesForSATA.infbd** file, you get an additional library window with predefined SATA test cases, similar to the following:

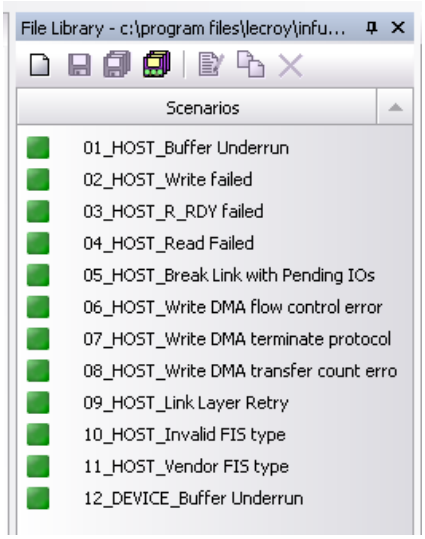


Figure 4.13: Test Cases for SATA Library

4.5.3 Device Libraries

In addition to general libraries, the application defines device libraries. Each device library is associated with a specific InFusion device. Each device library opens in a separate Device Library window and holds up to ten InFusion scenarios for the device. When you connect to the device and click the entry for that device in the Device List, the device library for the device opens automatically.

The scenarios that appear in the device library are those currently stored on the corresponding device. They were uploaded from the device to your host machine when you opened the device library. You can click any of the scenarios listed to open it for editing. When you are finished with your edits, you can use the buttons on the Device Library toolbar to download the revised scenario to the device.

The None scenario is an empty and undefined scenario to allow you to assign port(s) to None.

The Multiport feature allows you to run a scenario by more than one port in a Device Library and to assign different ports to different scenarios and run them together. Each scenario in a library can run by more than one port.

4.6 Scenario Properties

To begin the scenario creation process, you click the **New Scenario** button in a library window or on the InFusion application toolbar. As the first step in creating a scenario, the application prompts you for scenario name, a short description (optional), and the direction of traffic to which any traffic changes apply. Changes are, for example, injection or removal of data or a primitive.

You identify direction of traffic change, or modification, in terms of traffic origin. The application uses the following conventions:

- **From Initiator**: Change is made to traffic coming from test host (for example, CRC error is injected into traffic stream sent from initiator to target).
- **From Target**: Modification is made to traffic coming from the target (for example, CRC error is injected into traffic stream sent from target to initiator).

The figure shows the first prompt in the scenario creation process.

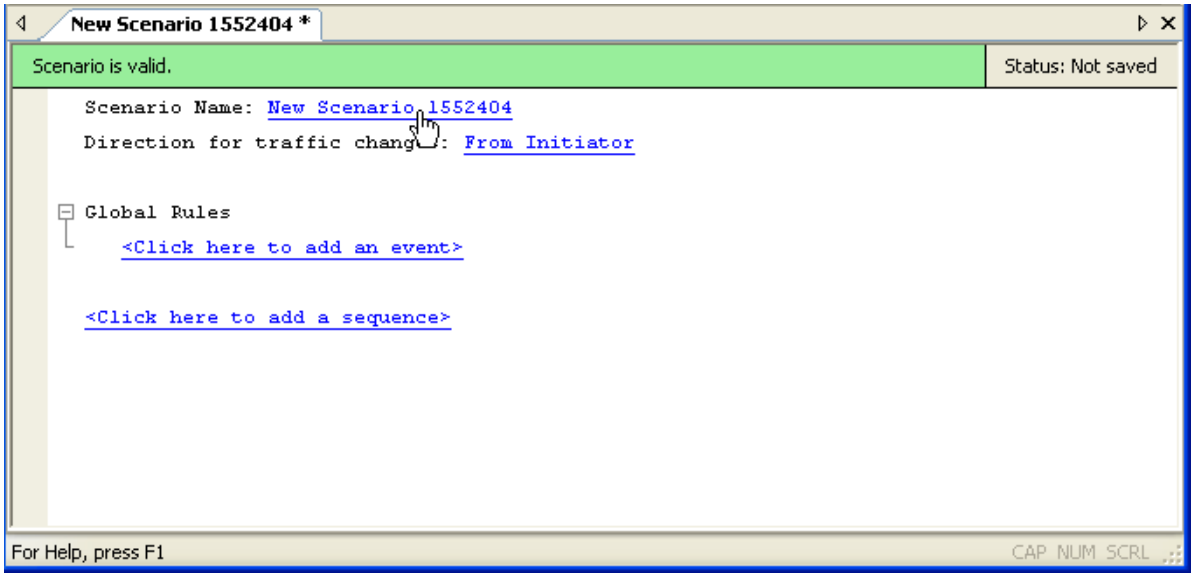


Figure 4.14: Entering Basic Scenario Information

To copy an event or action, right-click on the event or action and select **Copy**. Right-click **Click here to add another event** or **Click here to add an action** and then select **Paste**.

To copy a sequence or state, right-click on the sequence or state and select **Copy**. Right-click **Click here to add another sequence** or **Click here to add another state** and then select **Paste**.

You can also cut, delete, and edit a selected sequence, state, event, or action.

When you click the Scenario Name or the Direction For Traffic Changes, the Scenario Properties dialog box displays (see Figure 4.15 on page 343), allowing you to enter the scenario name, a short description, and direction of traffic change.

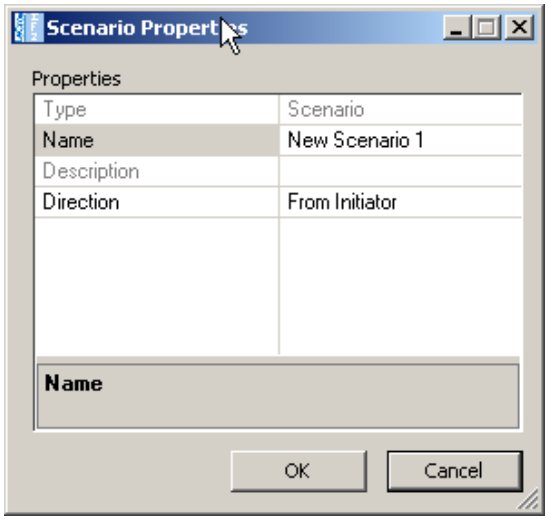


Figure 4.15: Scenario Properties Dialog Box

In the Scenario Properties screen, the direction for traffic modification is defined on a global basis for the entire scenario. In other words, any scenario action that modifies line traffic only affects the traffic flowing in the direction established at the top of the scenario, in the Scenario Properties. Scenario events can be monitored in either direction, and therefore the parameters for events provide the ability to specify the intended direction for monitoring traffic for that event.

SATA Smart Hold Option

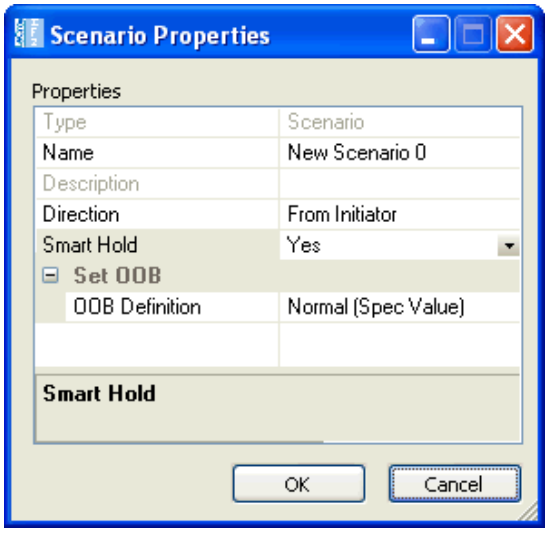


Figure 4.16: SATA Scenario Properties Dialog Box

SATA Scenario Properties have a Smart Hold option, which is on by default.

Each port monitors incoming data, which originated with the other device's receiver, as close as possible to where it enters the bus engine. If a port detects a HOLD primitive during a SATA frame, the port stops reading data from the FIFO and generates HOLDA. The HOLD propagates through the bus engine and eventually goes to the other device,

where the HOLD causes the other device to send HOLDA. (The bus engine FIFOs must be deep enough to hold all the traffic that the other device sends while the HOLD propagates. The port drops all incoming HOLDA conditions, so HOLDAs are never put in the FIFOs or made visible to the sequencers.)

After this, the port that had been receiving the HOLD stops sending HOLDA and attempts to read data from the FIFO. The termination of HOLD propagates through the bus engine and then causes the other device to restart transmission, which puts data into the FIFO.

Note: If both sides send HOLD primitives that overlap, the receivers drop the HOLD conditions to avoid overflowing the FIFOs.

If you turn off the Smart Hold option, the port does not send HOLDA when it detects a HOLD primitive during a SATA frame.

4.7 Scenario Events

A scenario is a script you create using simple mouse clicks and text entries. As you work, the script takes shape in the scenario area of the application display. You can think of the scenario area itself as consisting of two subareas: A Global Rules area at the top, where you create the Global Rules, and a Sequence area beneath the Global Rules, where you create any sequences. Whether you are creating Global Rules or a Sequence, the menu-driven interface prompts you to specify the event(s) for which you want to trigger actions (see Figure 4.17 on page 345).

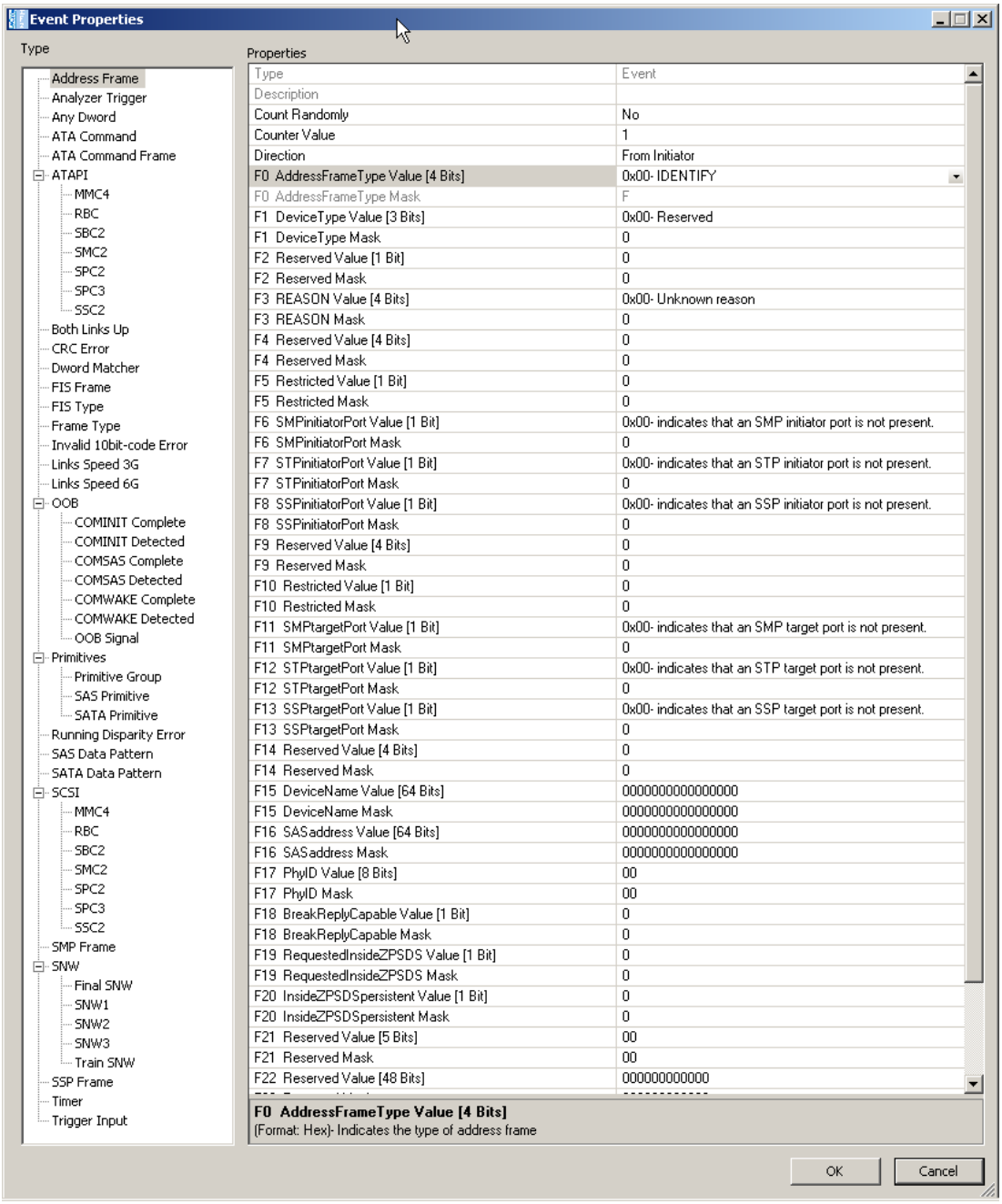


Figure 4.17: Event Properties Dialog

While many events are line conditions, an event also can be a condition that occurs within a InFusion device (for example, detection of a trigger signal from another device).
The following table lists supported events. Note that some events are applicable only in the context of creating sequences (those events appear on the drop-down list only if you are creating a sequence). Sequences can have multiple states, and they allow branching between states.

TABLE 4.3: Events

Event	Description
Address Frame	Occurrence of a specified address frame.
Analyzer Trigger	Trigger on Analyzer when its event matches. You can see the trigger on the Status Bar, but the Port Status dialog does not display any mark in the Trigger column. **Note**: This is different than the external trigger mechanism. You do not need an external trigger cable. **Note**: The Trigger on Analyzer feature functions when the trigger pattern is set to "Pattern/Infusion" and running a scenario which will trigger analyzer after a 5s timer. A message "Triggered, Post-Trig Capturing" displays on the Software Status bar. **Note**: When the analyzer triggers, it triggers on a packet before the actual trigger event occurs. The trace triggers more than 1us before the event actually occurs. The trigger is on the Initator side instead of the Target side as set in the scenario.
Any DWORD	Occurrence of any DWORD.
ATA Command	Occurrence of a particular ATA command.
ATA Command Frame	Occurrence of a particular ATA command frame.
[+] ATAPI	Occurrence of a particular ATAPI command from the list: MMC4, RBC, SBC2, SMC2, SPC2, SPC3, or SSC2.
Both Links Up	Occurrence of both line ports active (not idling).
CRC Error	Occurrence of a CRC error.
DWORD Matcher	Occurrence of a particular DWORD.
FIS Frame	Occurrence of a particular FIS frame.
FIS Type	Occurrence of a particular SATA FIS type.
Frame Type	Occurrence of a particular frame type.
Invalid 10bit-code Error	Occurrence of an invalid 10b code.
Links Speed 3G	Both lines operating at 3 Gbps.
Links Speed 6G	Both lines operating at 6 Gbps.
OOB Signal	Occurrence of OOB signal.
[+] Primitives	Occurrence of Primitive Group, SAS Primitive, or SATA Primitive.
Running Disparity Error	Occurrence of Running Disparity (RD) error.
SAS Data Pattern	Occurrence of a particular data pattern in a SAS frame.
SATA Data Pattern	Occurrence of a particular data pattern in a SATA frame.
{+} SCSI	Occurrence of a particular SCSI command from the list: MMC4, RBC, SBC2, SMC2, SPC2, SPC3, or SSC2.
SMP Frame	Occurrence of a particular SMP frame.
SNW	Occurrence of Final SNW, SNW1, SNW2, SNW3, Train SNW
SSP Frame	Occurrence of a particular SSP frame.
Timer	Occurrence of a particular elapsed time (time period).

Event	Description
Trigger Input	Occurrence of input trigger.

The following sections provide some additional details about three of the above events.

DWORD Matcher

DWORD Matcher is a DWORD pattern matcher that presents match and mask fields and a K-Code Mask field. K-Codes are control characters that are always used in the first byte of a four-byte primitive. Of the K-Code masks listed in the menu, D-D-D-D is used for data bytes, and K-D-D-D is used for all primitives.

When you create a DWORD match, keep the following in mind:

- The pattern can be inside or outside of frames (it does not matter if the pattern is inside a frame or not).
- Because the pattern can be inside or outside of frames, there is no offset.
- You can make user-defined primitives. (This is the reason this feature was created.)
- You can use any K/D pattern.

SAS Data Pattern

When you create a SAS data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SOF or SOAF.
- The pattern must be data only (no K-codes/primitives).
- The pattern must be defined at a specific offset in the frame.
- The pattern and mask must be specified in the same format as specified in the SAS standard:
  0x12345678 (hex)
  where “1” is the first digit on the cable and is the MSB as given in the SAS Standard.

For example, for an SMP Request:

Pattern: 0x40000000

Mask: 0xFF000000

Offset: 0

SOF Type: SOF

SATA Data Pattern

When you create a SATA data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SATA_SOF.
- The pattern must be data only (no K-codes/primitives).
- The pattern must be defined at a specific offset in the frame.
- The pattern and mask must be specified in the same format as specified in the SATA Standard.

For example, for Register H -> D FIS:

Pattern: 0x00000027

Mask: 0x000000FF

Offset: 0

SOF Type: SATA_SOF

4.8 Scenario Actions

After you enter the set of events for a test state, the menu-driven interface prompts you for the corresponding action or set of actions. If you define multiple actions, the actions occur simultaneously.

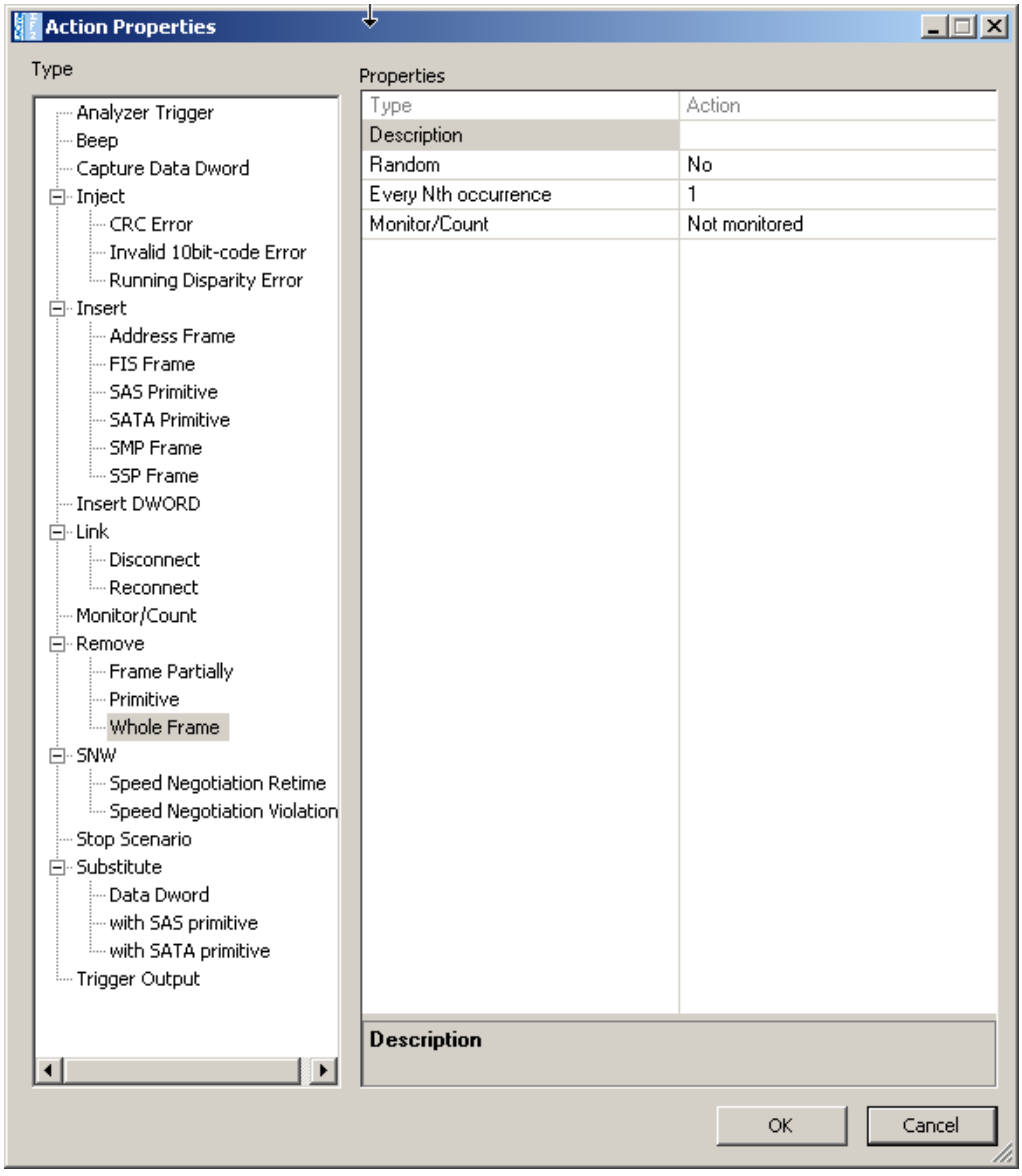


Figure 4.18: Action Properties Dialog

The following table lists supported actions. Note that some of these actions only apply to creating sequences.

TABLE 4.4: Test State Actions

Action		Description
Analyzer Trigger		The Jammer sends a trigger to the Analyzer.
Beep		Emits audible sound of duration selectable via drop-down list.
Branch to	Existing State[1]	Go to a state in this sequence that is already defined.[1]
	New State[1]	Go to a state in this sequence that is not yet defined (you need to define it).[1]
Capture Data DWORD		Captures a data DWORD into one of four registers.
Inject	CRC Error	Injects a CRC error into the line.
	Invalid 10bit-code Error	Injects invalid 10b code into the line.
	Running Disparity Error	Injects a Running Disparity (RD) error into traffic.
Insert	Address Frame FIS Frame SAS Primitive SMP Frame SSP Frame	Inserts a frame or primitive.
Insert DWORD		Inserts DWORD.
Link	Disconnect	Puts both InFusion SAS ports at electrical idle immediately.
	Reconnect	Starts traffic pass-through immediately. This action restarts traffic after a previous disconnect command. Once traffic is passing through, the initiator and target resume OOB signaling.
Monitor/Count		Opens a window to count the number of events that occur during a session. A session is a time interval during which a scenario runs.
Remove	Frame Partially Primitive Whole Frame	Removes the targeted event from the traffic.
Restart	All Sequences[1]	Restart all sequences in the scenario.[1]
	Current Sequence[1]	Restart the sequence that contains this action definition. [1]

Action		Description
SNW	Speed Negotiation Retime	Set RCDT, SNTT, ALT/TLT, TX speed, TRAIN/ TRAIN_DONE pattern, and/or PHY Capability.
	Speed Negotiation Violation	Set Violation Type.
Stop Scenario		Stops all scenario activity.
Substitute	Data DWORD	Substitutes a data DWORD in the traffic.
	with SAS Primitive	Substitutes a SAS primitive in the traffic.
	with SATA Primitive	Substitutes a SATA primitive in the traffic.
Trigger Output		Sends a signal out the trigger port to the device downstream.

[1] Only shown in Action Properties dialog box when creating a sequence.

Using Counters in Events and Actions

Many of the events and actions supported by InFusion also support counters that can control functions.

Within events, counters determine how many times the event must occur before the associated actions are triggered. Event counters typically have two properties:

- **Count Randomly**: Can be set to “Yes” or “No” (default value is “No”).
  If set to “Yes”, the event repeats a random number of times (between 1 and the value set in the property **Max Random Count**, which replaces the property **Counter Value** when “Yes” is selected), before the action is triggered.
- **Counter Value**: Number of repeats required when **Count Randomly** is set to “No”. The default value is 1.

Within actions, counters determine how many times the system calls the action before it acts. Action counters typically have two properties:

- **Random**: Can be set to “Yes” or “No” (default value is “No”).
  If set to “Yes”, the action triggers a number of occurrences before the action takes place. That number ranges randomly between 1 and the value set in the property **At least every Nth occurrence**, which replaces the property **Every Nth occurrence** when “Yes” is selected.
- **Every Nth occurrence**: Number of times the system calls the action before it acts.

Note that there is some overlap in the way these counters can be used. For example, in the simple case of a single event leading to a single action, it makes no difference whether you specify the event to require five repeats before triggering the action, or the action to require five occurrences before it acts.

However, in the case of combined events and/or actions, the separate counters provide flexibility in designing test cases. For example, consider the case where Event_1 OR Event_2 leads to Action. If Event_1 has a counter of 5, then the Action triggers either when Event_1 has repeated five times or when Event_2 happens the first time, whichever occurs first.

But if the event counters are set to 1 and the Action counter is set to 5, then the Action happens after five occurrences of EITHER Event_1 or Event_2.

Capturing a Data DWORD

InFusion provides the ability to capture individual data DWORDs and provides four different registers to store captured DWORDs (DWORD #0, #1, #2 and #3).

To capture a data dword, select **Capture Data DWORD** from the Action Properties screen, as shown below. Select the register to be used to store the DWORD from the drop-down menu under the **Capture Register** property.

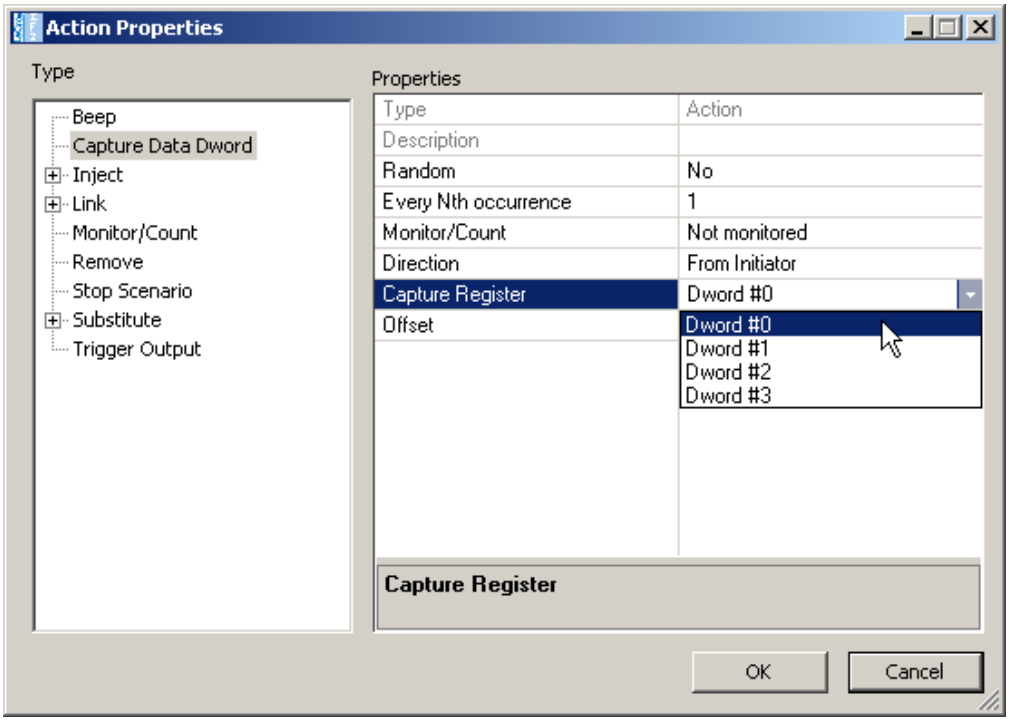


Figure 4.19: Capture Data DWORD Action

Using Captured Data DWORDs

Captured data DWORDs can be used in creating events for data that match the captured DWORD(s), or in creating actions to substitute the captured DWORD(s) into the data stream.

To create an event using the captured DWORD, in the Event Properties menu, select **SAS Data Pattern** (or **SATA Data Pattern**), and then select any of the 12 DWORDs (**DWORD 0 Type** through **DWORD 11 Type**). The drop-down menu provides the choice of a custom DWORD or any of the four captured DWORDs. If you select a captured DWORD, the **Value** field beneath this selection is hidden (the **Value** field is only used for specifying custom DWORDs). Note that choice of a mask and an offset are still available when using captured DWORDs.

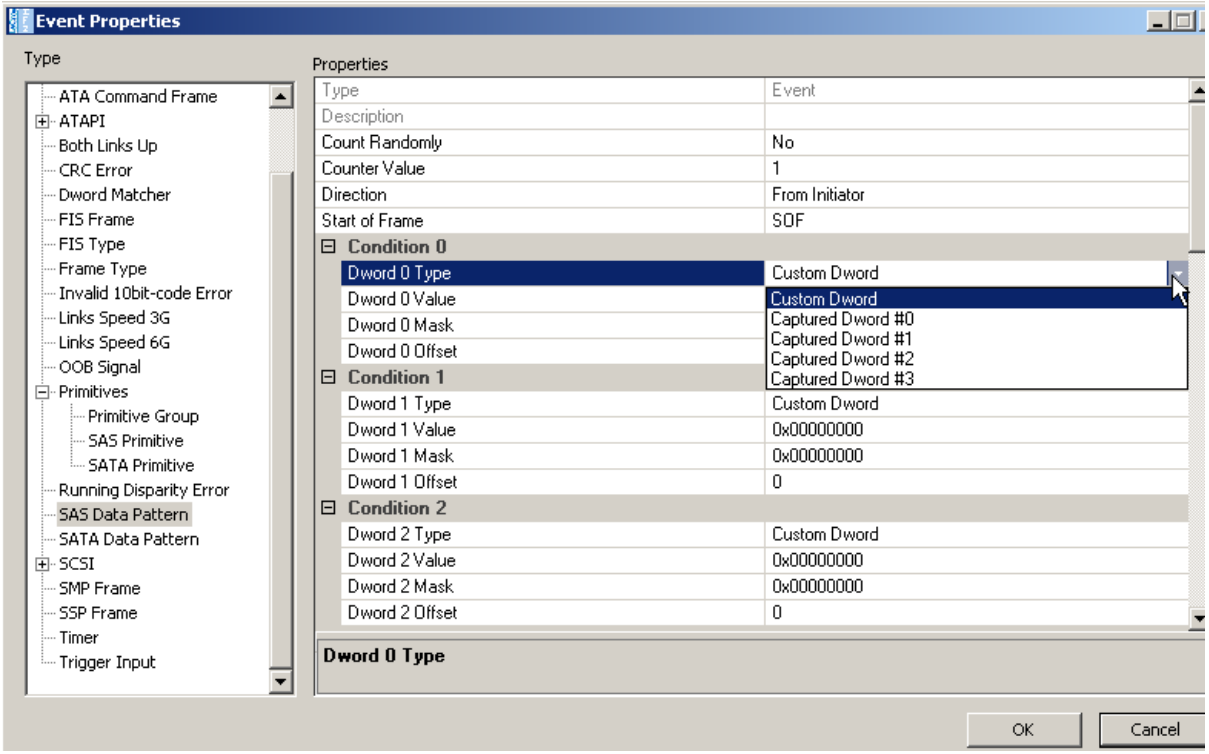


Figure 4.20: Using a Captured DWORD in a SAS Data Pattern

Captured data DWORDs may also be used in the **Substitute Data DWORD** test state action. From the Action Properties screen, choose **Substitute Data DWORD** and then select the **Substitute for** property. A drop-down menu is provided (see below) that allows the choice of a custom DWORD or any of the four captured DWORD registers.

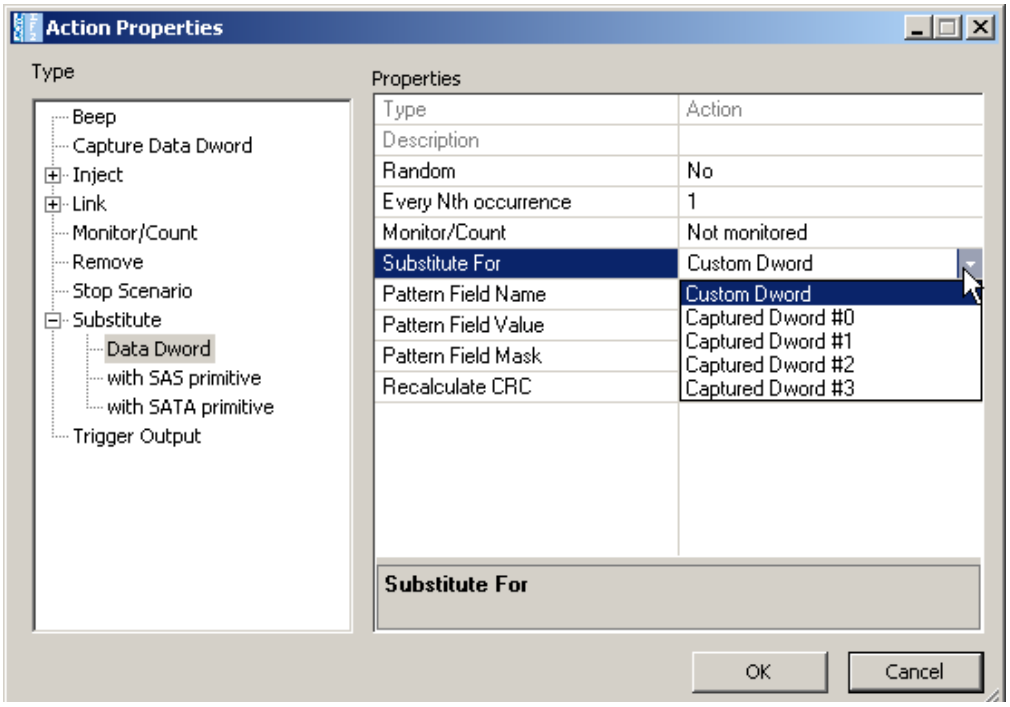


Figure 4.21: Using a Captured Data DWORD in Substitute DWORD Test Action

4.8.1 Summary of Scenario Creation

The suggested process of creating and executing a scenario is as follows:

1. Create a scenario in the main library.
2. Copy the scenario from main library to a device library by drag-and-drop with a mouse. (Each device library is associated with a specific InFusion device.)
3. Download all scenarios in the device library to a InFusion device.
4. Select the scenario in the device library that you want to run on the device.
5. To run the scenario, click the **Start Scenario** button from the Device Library toolbar. The device starts to monitor/modify traffic.

Note: Step 1 is described in detail for each example in following sections. Steps 2 to 5 are described in detail at the end of this chapter.

4.9 Creating Global Rules

This section gives examples for creating the Global Rules area of a scenario. Recall that the Global Rules area defines a single test state. The Global Rules do not have the capacity for multiple states, so that area of a scenario cannot change state.

In terms of InFusion testing, a state defines test “behavior.” In this context, behavior is “waiting” for an event and responding with an action or set of actions that happen simultaneously.

Keep in mind that a test state you implement with the Global Rules operates in parallel with the active test state of each sequence in the scenario.

In effect, InFusion lets you do up to three line tests at the same time. You can do one test with the Global Rules and a separate test with each sequence you create. You can have up to two sequences in a scenario.

The following table summarizes the Global Rules examples that follow.

TABLE 4.5: Global Rules Examples

Example	Description
1	Creating a single event and action (removes a primitive).
2	Creating a single event and action (replaces a primitive).
3	Creating a combined event (a logical OR association of multiple events) and an action.
4	Creating multiple triggers and actions.
5	Creating multiple actions on a single event.
6	Using timers.

4.9.1 Example 1: Creating a Single Event and Action that Removes a Primitive

In this example, the Global Rules area of the scenario waits for each RRDY Normal primitive from the initiator and removes it.

1. Click the **New Scenario** button in the main library or one of the device libraries.
2. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change (see Figure 4.15 on page 343).
3. In the Global Rules area, click the prompt to **add an event**.

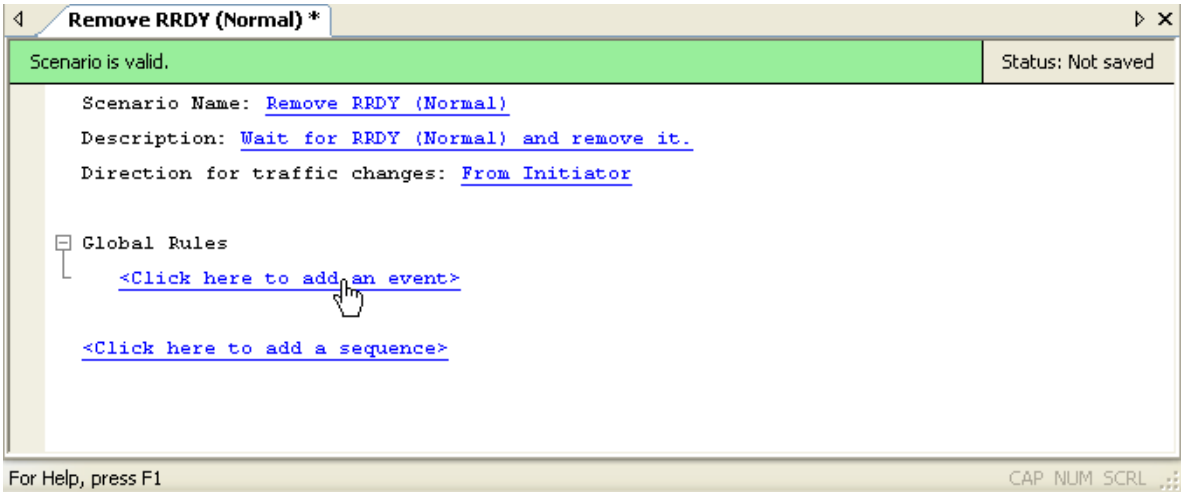


Figure 4.22: Example 1: Adding an Event

The Event Properties dialog box appears (see Figure 4.17 on page 345).

4. In the Type column of the Event Properties dialog, choose **Primitive > SAS Primitive**.
5. In the Type column in the middle of the dialog box, click **Description** if you want to add a description of the event.
6. Click **Direction** to choose the direction of traffic to monitor for the selected event (the default is **From Initiator**, which is what you want for this example).
7. Still in the middle column of the Event Properties dialog box, click **Primitive** to display a drop-down menu that lets you choose the type of primitive for which you want to wait in this scenario. In this example, it is **RRDY (Normal)**.

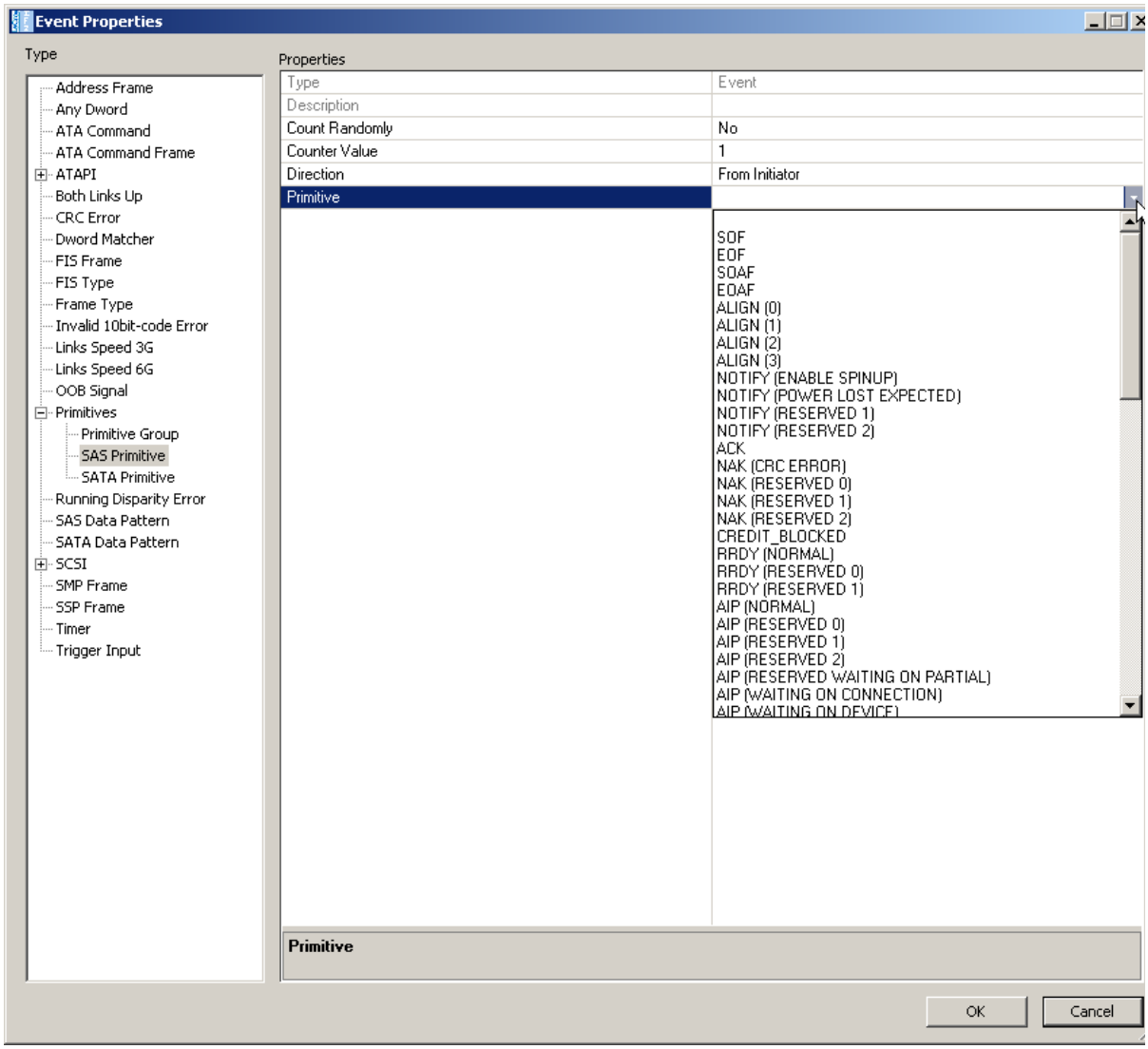


Figure 4.23: Example 1: Event Drop-Down List

8. Click **OK** to close the Event Properties dialog box.
9. In the Global Rules area, click the prompt to **add an action** (see Figure 4.24 on page 356).

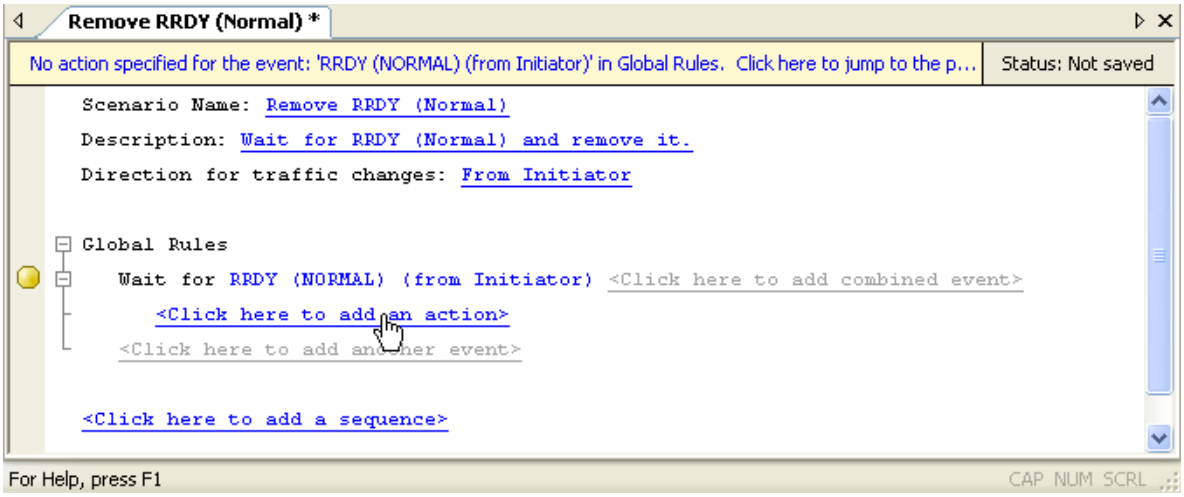


Figure 4.24: Example 1: Entering an Action

The Action Properties dialog box appears (see Figure 4.18 on page 348).

10. In the Type column on the left, choose the action that you want to occur when an RRDY is detected. In this example, it is the **Remove Primitive** action. Select Random **Yes** or **No**, **N** for Every Nth occurrence, and Monitor/Count as **Monitored** or **Not Monitored**.
11. Click **OK** to close the Action Properties dialog box.

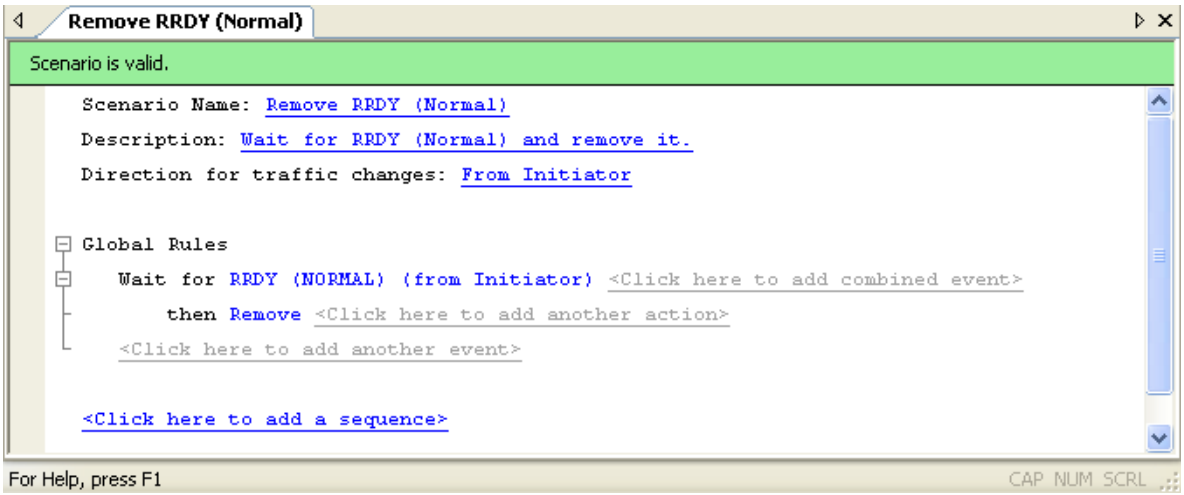


Figure 4.25: Example1: Complete Scenario

12. In the File menu, select **Save Scenario** to save the scenario.

4.9.2 Example 2: Wait for a Primitive and Replace It with an Error

In this example, the Global Rules portion of the scenario waits for each RRDY Normal primitive and replaces it with an ERROR primitive.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.

2. In the Global Rules area, click the prompt to **add an event** to display the Event Properties dialog box.
3. As you did in the previous example, choose **RRDY (Normal)** as the type of primitive to monitor.
4. In the Global Rules area, click the prompt to **add an action** to display the Action Properties dialog box.
5. In the Type column on the left, choose **Substitute > with SAS Primitive** as the action that you want when an RRDY (Normal) occurs.
6. In the middle column of the dialog box, click **Description** if you want to add a description of the action.
7. Still in the middle column of the Event Properties dialog box, click **Primitive** to display a drop-down menu that lets you choose the type of primitive for which to substitute for RRDY (Normal) (see Figure 4.23 on page 355). Choose **ERROR**.
8. Click **OK** to close the Action Properties dialog box.
9. In the File menu, select **Save Scenario** to save the scenario.

   In this example, you set the substitution action to happen at every occurrence of an RRDY (Normal) (as shown in the figure, the action is set for every occurrence). However, you can set an action to happen at other multiples of event occurrence (for example 5, 25, 1000 and so on). You also can set the action to happen at random, within a specified number of event occurrences.

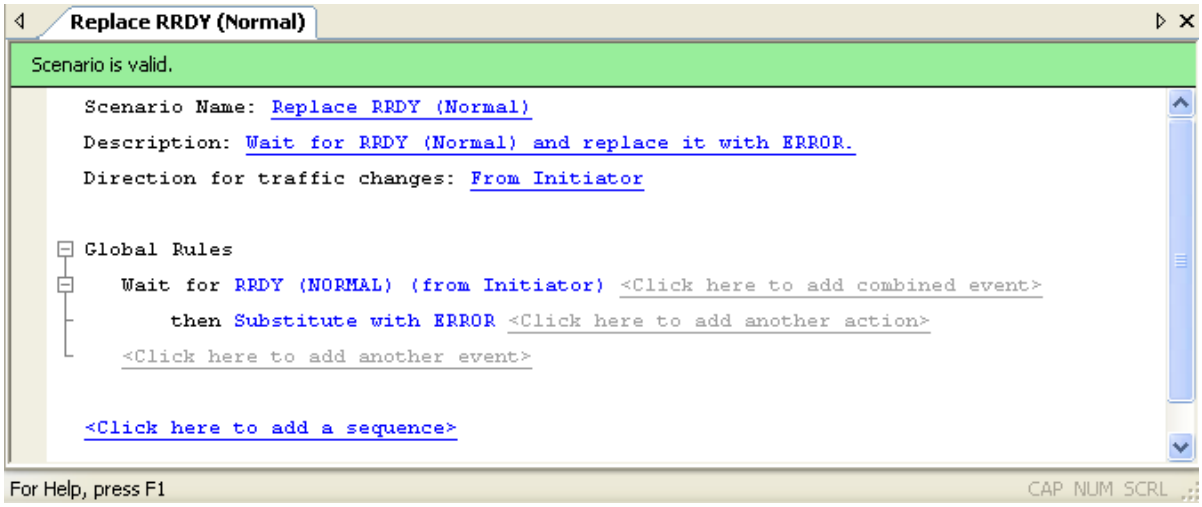


Figure 4.26: Example 2: Complete Scenario

4.9.3 Example 3: Creating OR Conditions

In this example, the Global Rules area of the scenario waits for either of two types of RRDY primitive and replaces them with an ERROR primitive.

This example includes a combined event (a logical OR association of two or more single events). Here, the combined event consists of any occurrence of RRDY (Normal) or RRDY (Reserved 0).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. In the Global Rules area, click the prompt to **add an event** to display the Event Properties dialog box.
3. As you did in example 1 of this chapter, choose **RRDY (Normal)** as the first primitive that you want to monitor.
4. Click the **add combined event** prompt to add a second event.

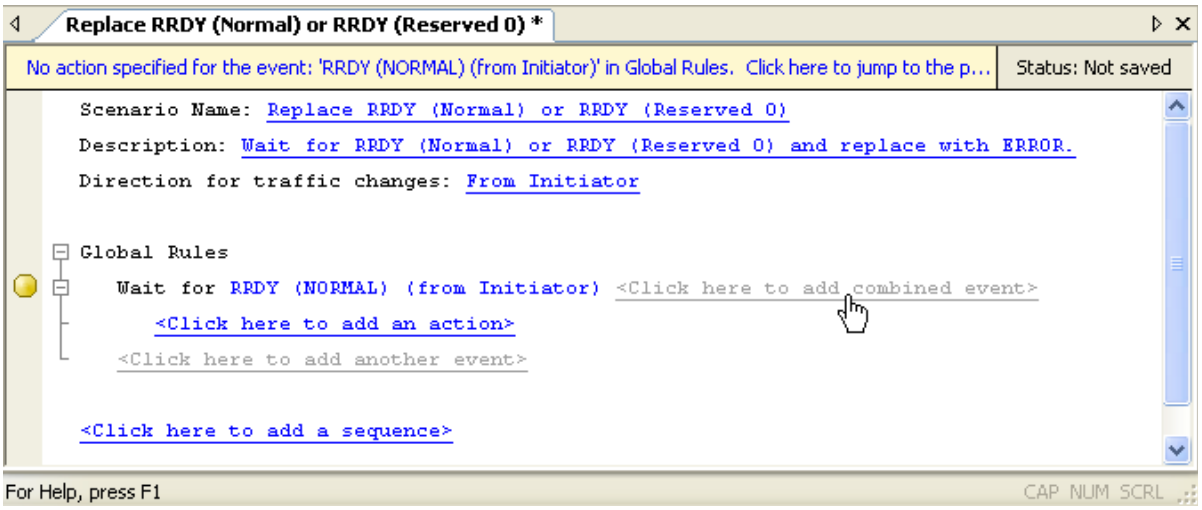


Figure 4.27: Example 3: Entering the Second Event

The Event Properties dialog box displays.

5. Choose **RRDY (Reserved 0)** as the second primitive that you want to monitor.
6. Click **OK** to close the Event Properties dialog box.
7. In the Global Rules area, click the prompt to **add an action** to display the Action Properties dialog box.
8. In the Type list on the left, choose **Substitute SAS Primitive** as the action that you want when either RRDY Reserved 0 or RRDY Normal occurs.
9. Click **OK** to close the Action Properties dialog box.

10. In the File menu, select **Save Scenario** to save the scenario.

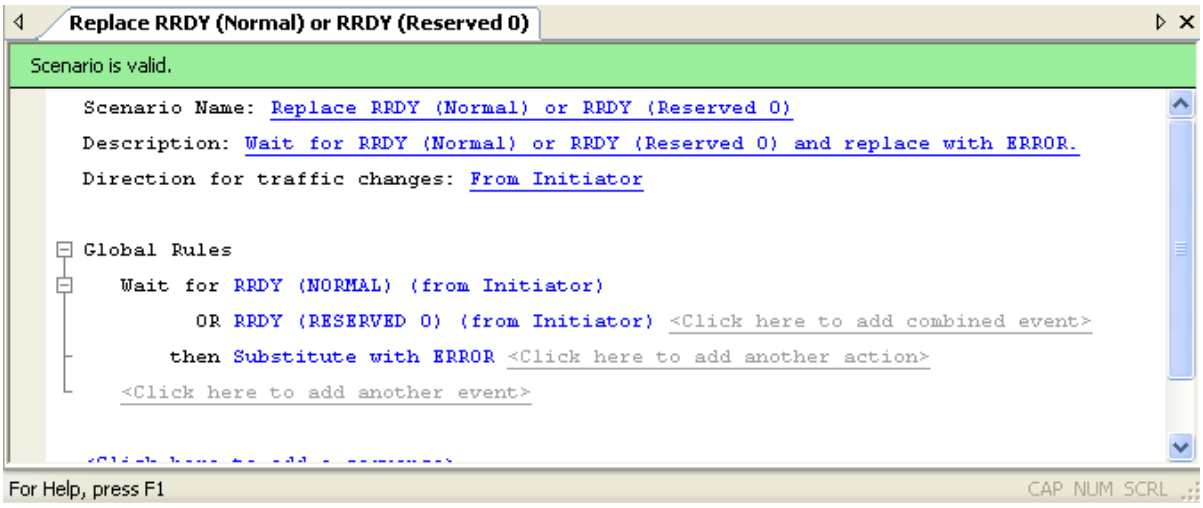


Figure 4.28: Example 3: Complete Scenario

4.9.4 Example 4: Multiple Triggers and Actions

In this example, the Global Rules area of the scenario waits for two events, each of which triggers a different action.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As you did in example 2, choose **RRDY (Normal)** as the first event to monitor, and substitute with the SAS primitive **ERROR** as action.
3. In the Global Rules area, click the prompt to **add another event** (keep in mind this is not a combined event).

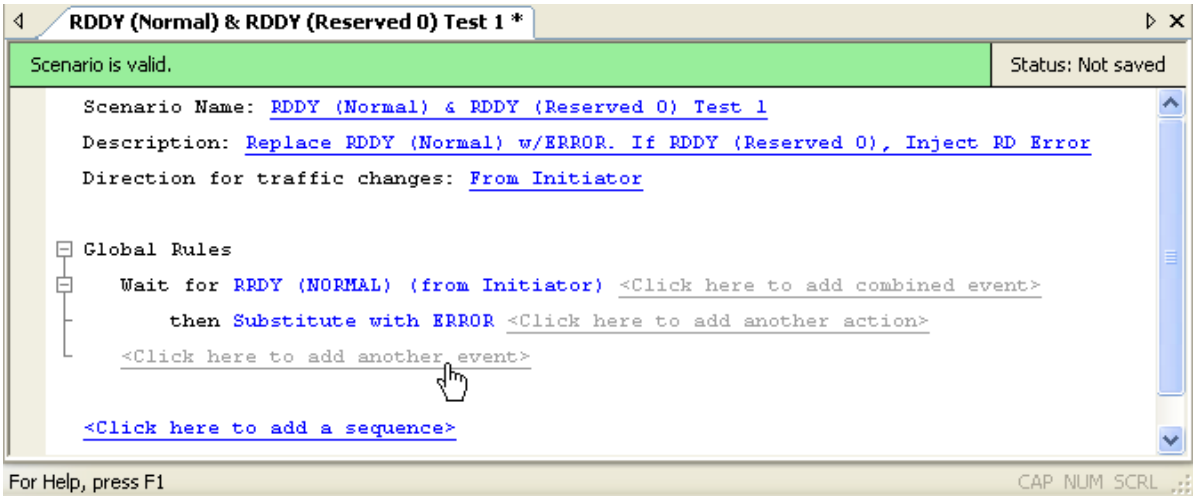


Figure 4.29: Example 4: Entering Second Event

The Event Properties dialog box displays.

In this example, there is a parallel set of events, but each event is associated with its own action. In a combined event, there is a parallel set of events sharing the same action.

4. Using the drop-down menu, choose **RRDY (Reserved 0)** as the second event to monitor.
5. Click **OK** to close the Event Properties dialog box.
6. In the Global Rules area, click the prompt to **add an action** to be triggered by the RRDY (Reserved 0).

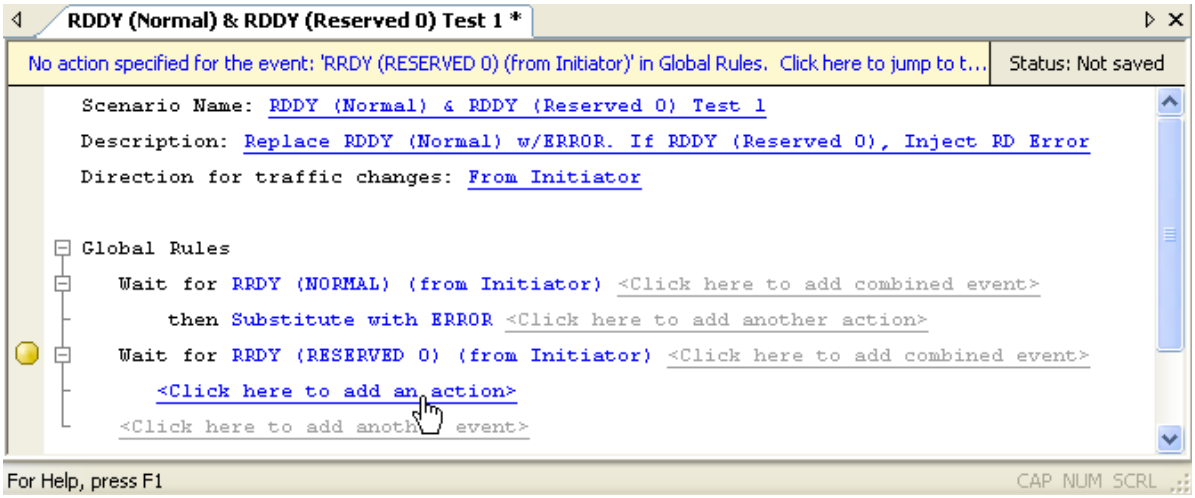


Figure 4.30: Example 4: Entering Second Action

The Action Properties dialog box appears.

7. Use it to choose **Inject RD Error** as the action triggered by RRDY (Reserved 0).
8. Click **OK** to close the Action Properties dialog box.

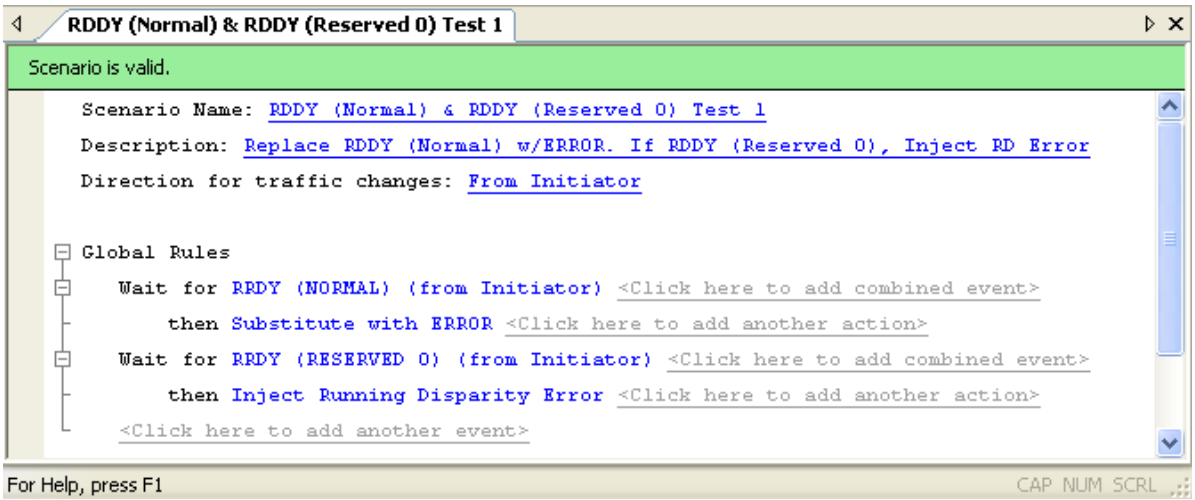


Figure 4.31: Example 4: Complete Scenario

9. In the File menu, select **Save Scenario** to save the scenario.

4.9.5 Example 5: Multiple Actions on a Single Event

In this example, an event triggers a set of actions. The actions occur at the same time. The device waits for an ACK from the initiator. When it occurs, the device beeps, injects an RD error, and increments a counter monitoring for that event (ACK from initiator).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event and **Beep** as the action. From the Action Properties drop-down menu, enter **500 ms** as the duration of the beep.
3. Click the **add another action** prompt to add a second action.

Figure 4.32: Example 5: Entering the Second Action

The Action Properties dialog box appears.

4. Choose **Inject RD Error** as the second action.
5. Click the **add another action** prompt to add a third action.
   The Action Properties dialog box appears.
6. Choose **Monitor/Count** as the third action.
7. Click **OK** to close the Action Properties dialog box.

Figure 4.33: Example 5: Complete Scenario

8. In the File menu, select **Save Scenario** to save the scenario.

   This example sets the counter to increment at each occurrence of an ACK (every 1 ACK).

4.9.6 Example 6: Using Timers

In this example, the Global Rules portion of the scenario waits for an ACK primitive from the initiator. Each time the device detects an ACK, it injects an RD Error into the traffic stream. This state continues for a random period of time, not to exceed 1.790 seconds. After the time period has elapsed (timer times out), the scenario stops.

Although this example sets the timer for a random period, you also can set the timer for known values (2 ms., 5 mins., 1 hr., and so on).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event and **Inject RD Error** as the action.
3. Click the prompt to **add another event** (keep in mind this is not a combined event) (see Figure 4.24 on page 356).

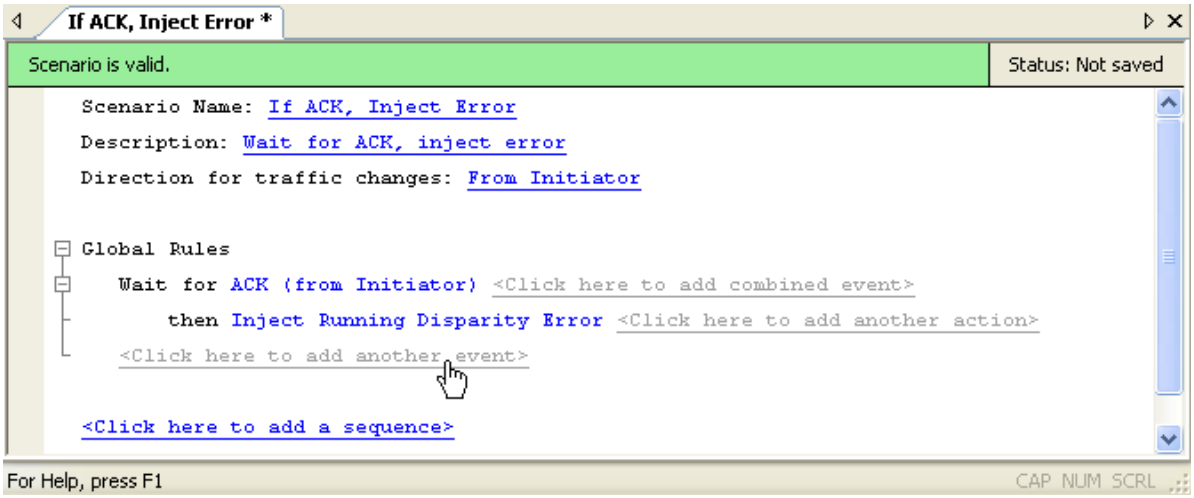


Figure 4.34: Example 6: Entering the Second Event

The Event Properties dialog box appears.

4. In the Type column on the left, choose **Timer**. Set the timer for random timing with a maximum time limit of 1.790 seconds.
5. Click **OK** to close the Event Properties dialog box.
6. Click the prompt to **add an action** to correspond with the second event.

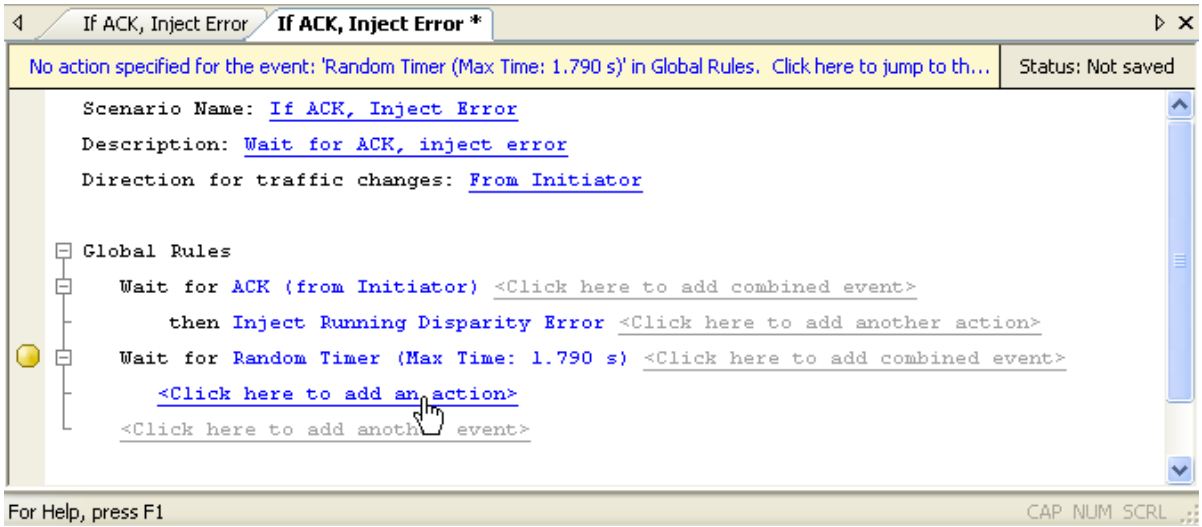


Figure 4.35: Example 6: Entering Second Action

The Action Properties dialog box appears.

7. In the Type list on the left, choose **Stop Scenario** as the action that you want after the timer has expired.
8. Click **OK** to close the Action Properties dialog box.

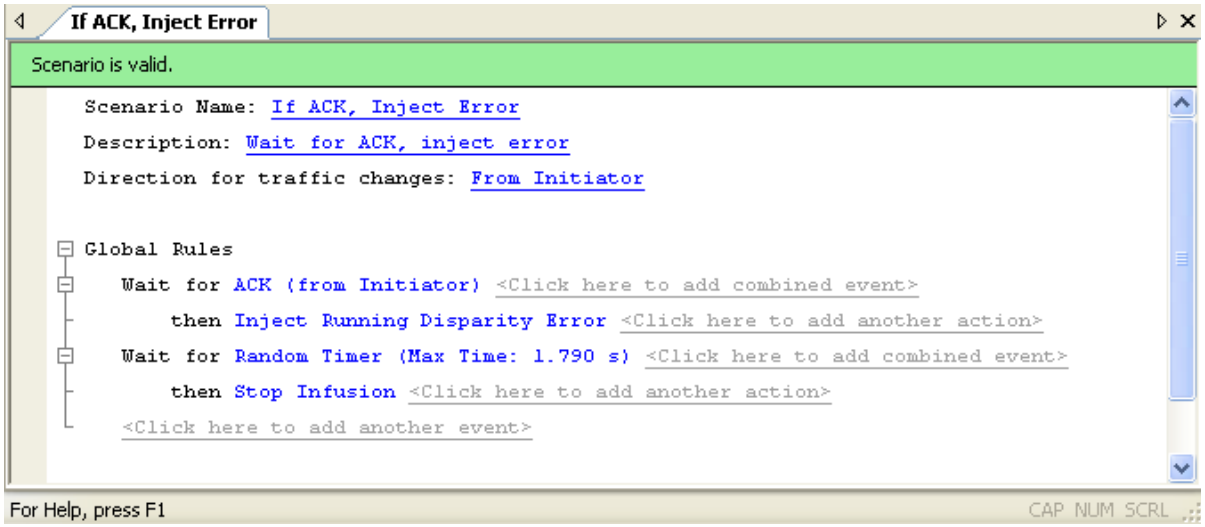


Figure 4.36: Example 6: Complete Scenario

9. In the File menu, select **Save Scenario** to save the scenario.

4.10 Creating a Sequence

This section gives several examples for creating sequences. Recall that a sequence can have multiple states, but only one state is active at any time. In other words, at any point in time, a sequence “waits” for one event (or combined event) and responds with the corresponding action or set of actions when the event occurs.

A sequence is more powerful than Global Rules, because you can create branching or looping test logic with a sequence.You can include up to two sequences in a scenario, but each is completely independent of the other. There is no branching or other interaction between the two, except through the Restart All Sequences action.

You must follow some simple rules when creating sequences:

TABLE 4.6: Sequence Rules

You can use only two branch actions per state. When you specify actions for a state, you can only use two instances of **Branch to an Existing State** or **Branch to a New State**. If you try to use more than two, a red error message appears in the status area of the application that says “Too Many Actions.”
You can use only one restart sequence action per state. When you specify actions for a state, you can only use one instance of **Restart Current Sequence** or **Restart All Sequences**. If you try to use more than one, a red error message appears in the status area of the application that says “Too Many Actions.”
You can use a maximum of 255 states per sequence. If you try to use more than 255 states, a red error message appears in the status area of the application.

The following table summarizes the examples that follow.

TABLE 4.7: Sequence Examples

Example	Description
7	**Creating two sequences and Global Rules**: This scenario has two objectives that you implement with Global Rules and two sequences. 1) You use Global Rules to replace any of three types of primitives. 2) You use two sequences to detect the order in which a type of frame is received from initiator and target.
8	**Creating a sequence with many states #1**: The objective of this scenario is to detect an incorrect order of primitives and to cause the device to beep when it happens. You implement this scenario with a single five-state sequence.
9	**Creating a sequence with many states #2**: This scenario is an enhancement of example 8. In this scenario, the objective is to detect an incorrect order of primitives, fix it, and cause the device to beep when this happens. As with example 8, you implement this scenario with a single five-state sequence.

4.10.1 Example 7: Creating Two Sequences and Global Rules

In this example, Global Rules substitute an Align (0) primitive for each of the following received from the initiator: Align (1), Align (2), and Align (3). As a separate test operation, two sequences determine the order in which each Identify Address frame is received from initiator and target.

The following tables summarize the logic implemented by each of the sequences.

TABLE 4.8: Example 7: Logic of Sequence 0

State	Description
State 0	If Address Frame is detected from initiator, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Address Frame detected is from target, beep 1 second.

TABLE 4.9: Example 7: Logic of Sequence 1

State	Description
State 0	If Address Frame is detected from target, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Address Frame detected is from initiator, beep 2 seconds.

There is no interaction between the two sequences. Each of them operates independently (and is independent of the Global Rules). However, the two sequences complement each other with their logic. In this sense, they both combine to implement a test objective.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the Global Rules area.
3. Click the prompt to **add a sequence**. Prompts for the sequence appear beneath the Global Rules area. You create a sequence one state at a time. The application numbers states consecutively from 0 up (1, 2, 3, and so on).

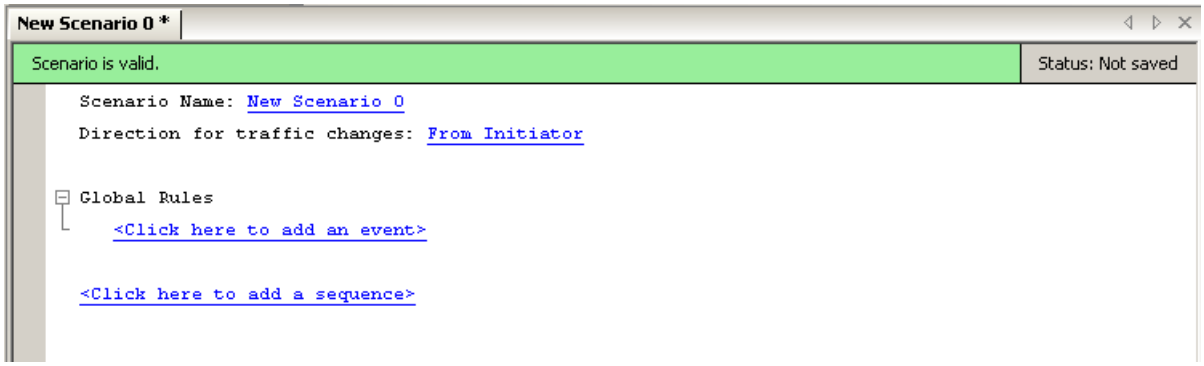


Figure 4.37: Example 7: Adding a Sequence

By default, the name of the first sequence in a scenario is Sequence 0. The name of the first state is State 0. To change the name of a sequence or state, or to associate a description with it, click the name of the sequence or state. A dialog box appears that allows you to enter that information.

Note: The description does not appear on screen, but you can bring it up by clicking the name of the sequence or state.

In the State 0 area, click the prompt to **add an event**.

Figure 4.38: Example 7: Adding an Event for the First State

The Event Properties dialog box displays.

1. In the Event Properties dialog box, select **Address Frame** as the event.
2. Click **OK** to close the Event Properties dialog box.
3. In the State 0 area, click the prompt to **add an action**.

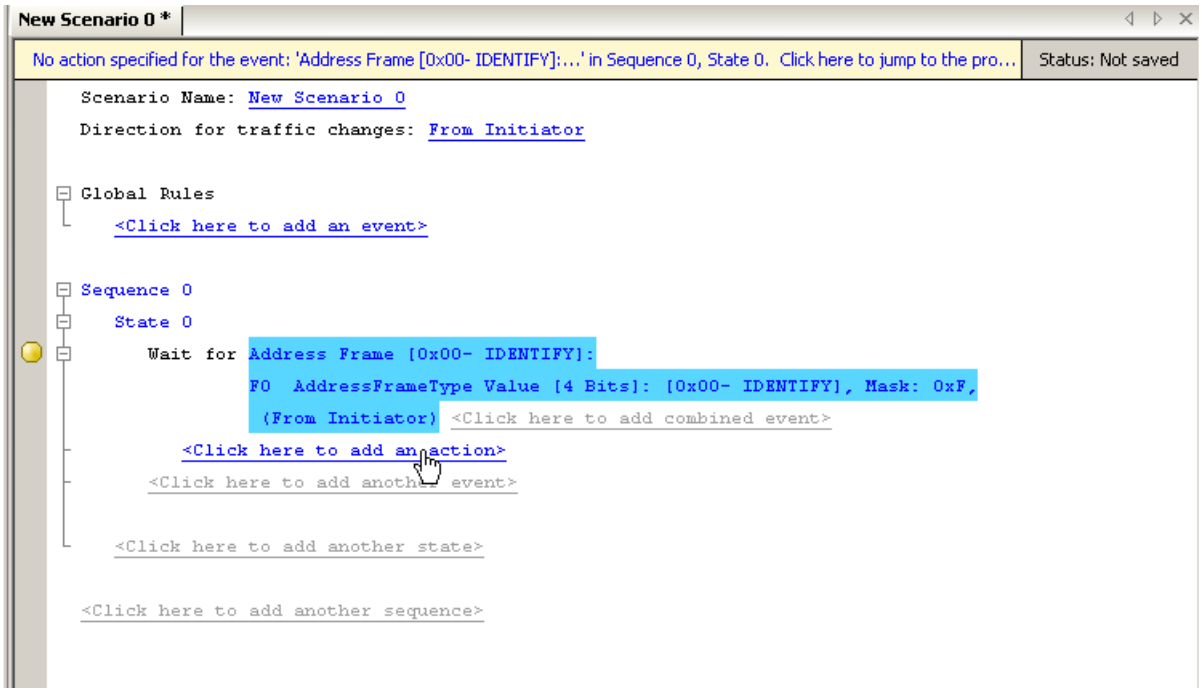


Figure 4.39: Example 7: Adding an Action for the First State

The Action Properties dialog box displays:

1. For the action, select **Branch to > New State**.
2. Click the **OK** button to close the Action Properties dialog box.
3. This saves the action and automatically creates an area for State 1 in the scenario.
4. In the State 1 area, click the prompt to **add an event**. The Event Properties dialog box appears.
5. Choose the **Address Frame** event. In the Direction column, select **From Target** (you want State 1 to trigger on an Identify Address frame received from the target).
6. Click **OK** to close the Event Properties dialog box.
7. Click the prompt to **add an action** for State 1.

Figure 4.40: Example 7: Adding an Action to the Second State

The Action Properties dialog box displays.

1. In this example, you enter the action **Beep**, and you set the duration of the beep for 1 second.
2. Click **OK** to close the Action Properties dialog box.
3. You are finished creating the first sequence. Click the **add another sequence** prompt to create an area in the scenario for the second sequence (Sequence 1) (see Figure 4.41 on page 369).

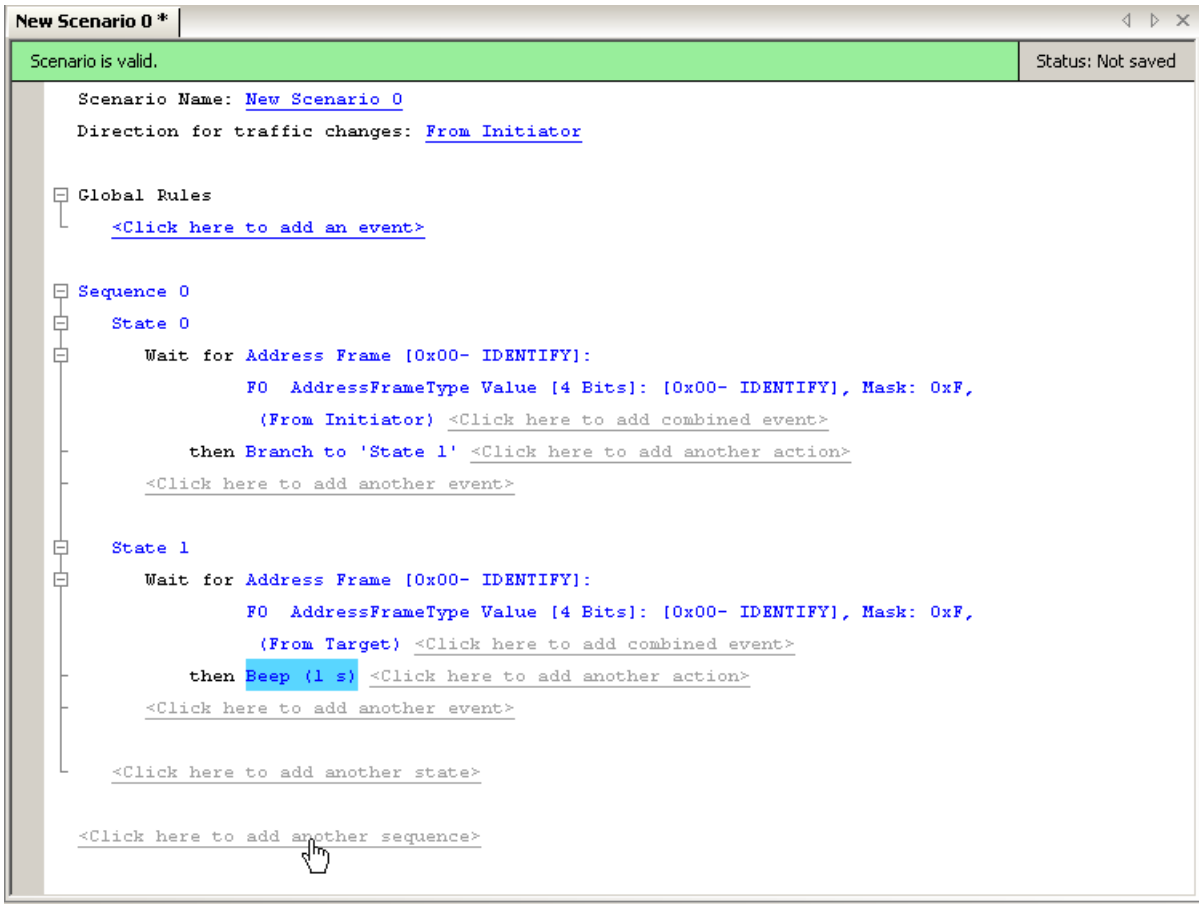


Figure 4.41: Example 7: Adding a Second Sequence

4. Create two states in the second sequence with the characteristics shown in the following table.

TABLE 4.10: Example 7: States for Second Sequence

State	Event	Action
0	Address Frame from Target	Branch to State 1
1	Address Frame from Initiator	Beep for 2 seconds.

5. In the File menu, select **Save Scenario** to save the scenario.

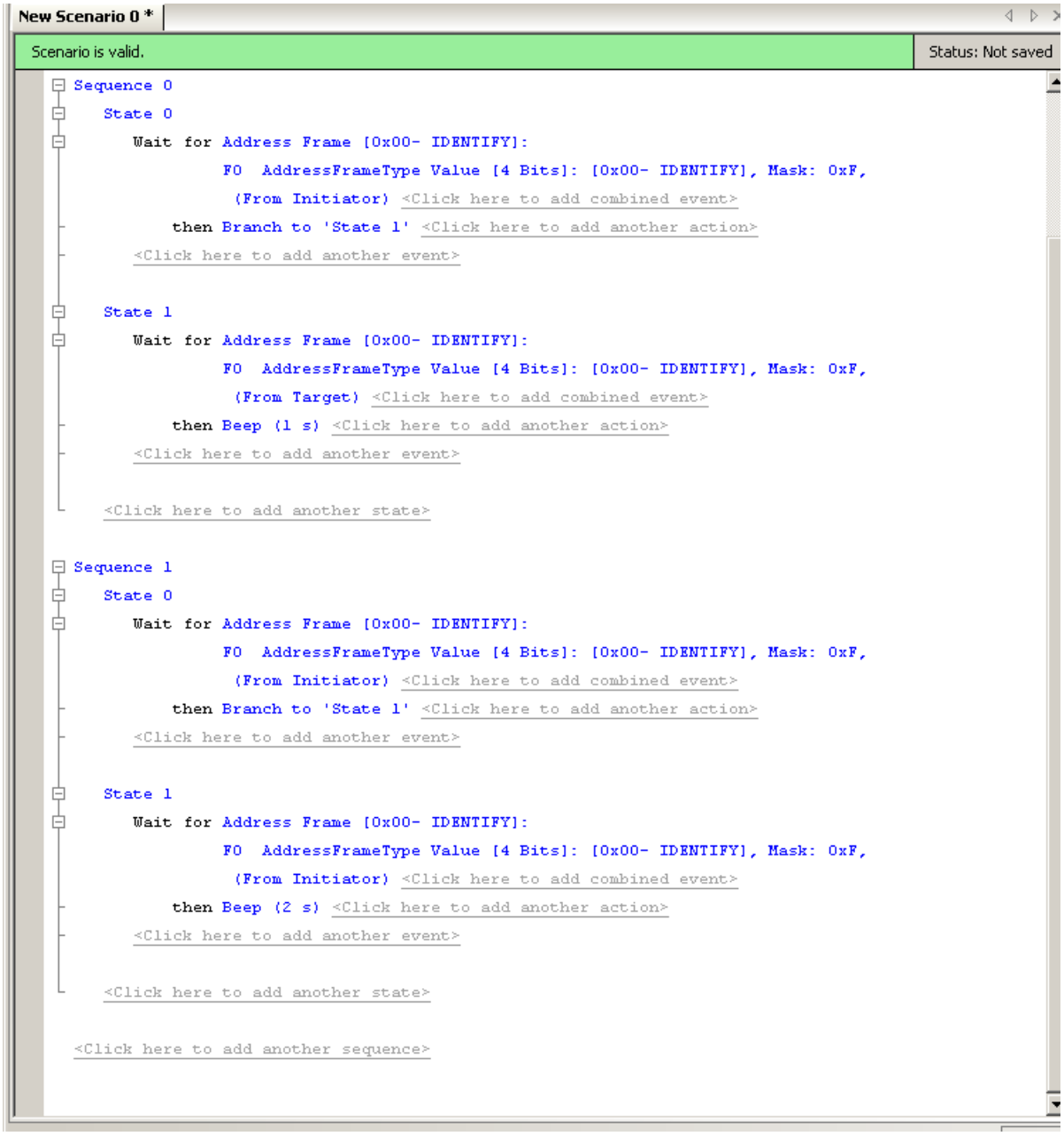


Figure 4.42: Example 7: Sequence Area of Scenario

4.11 Example 8: Creating a Sequence With Many States #1

In this example, a five-state sequence detects if a group of primitives is received out-of-order from the initiator. The expected order is: Align (0), Align (1), Align (2), Align (3). If this scenario detects any other order of these primitives, it causes the device to beep and the scenario to restart.

This example is designed to give you an idea of the powerful logic that you can implement with sequences.

Note that the states in this sequence have been renamed (do not have their default names). The following table summarizes the sequence logic.

TABLE 4.11: Example 8: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1).
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2); otherwise, go to Indicate Error.
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, go to Indicate Error.
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise go to Indicate Error.
Indicate Error	Indicate error and restart test.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the five states for this sequence.

3. In the File menu, select **Save Scenario** to save the scenario.

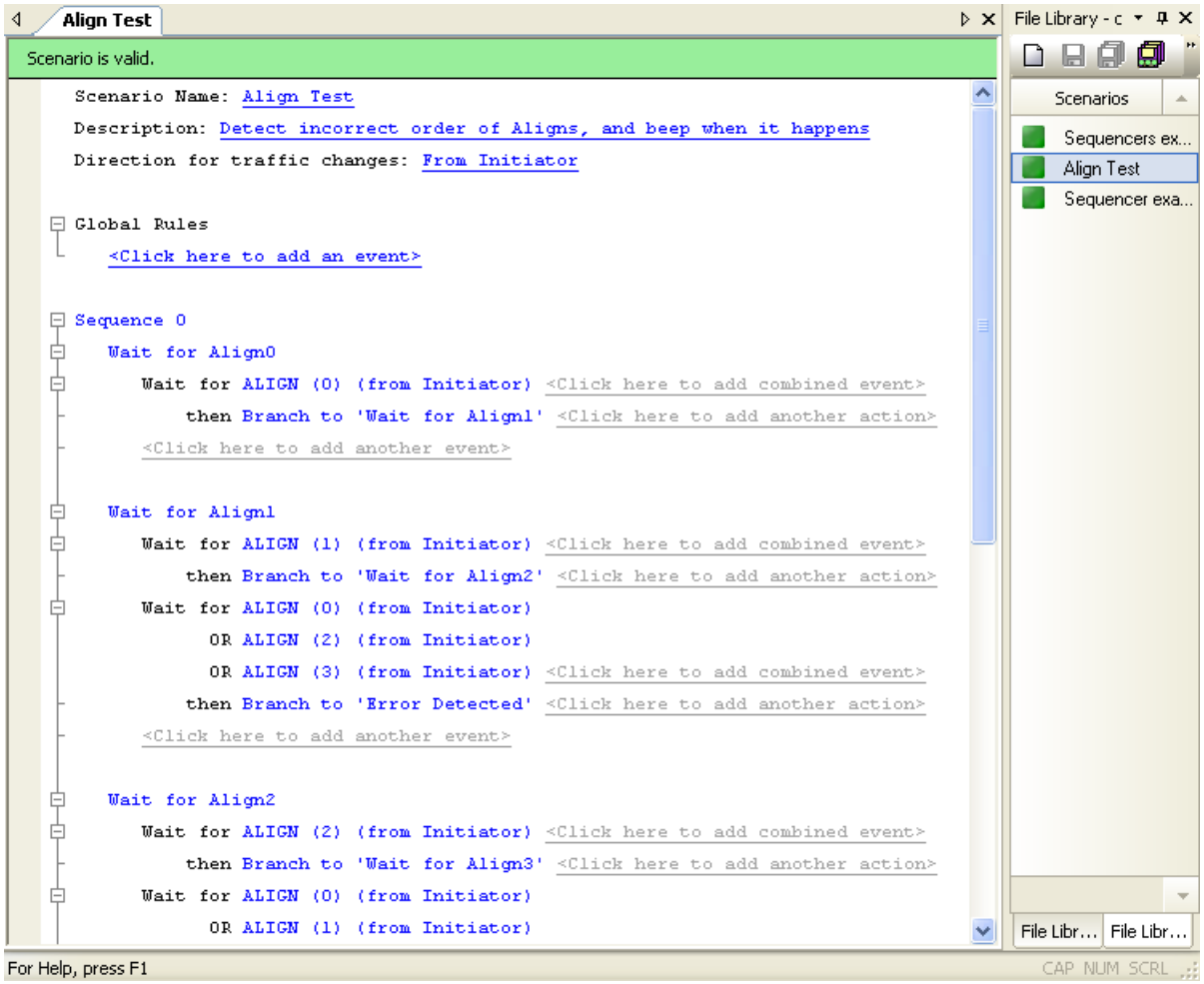


Figure 4.43: Example 8: Top Half of Scenario

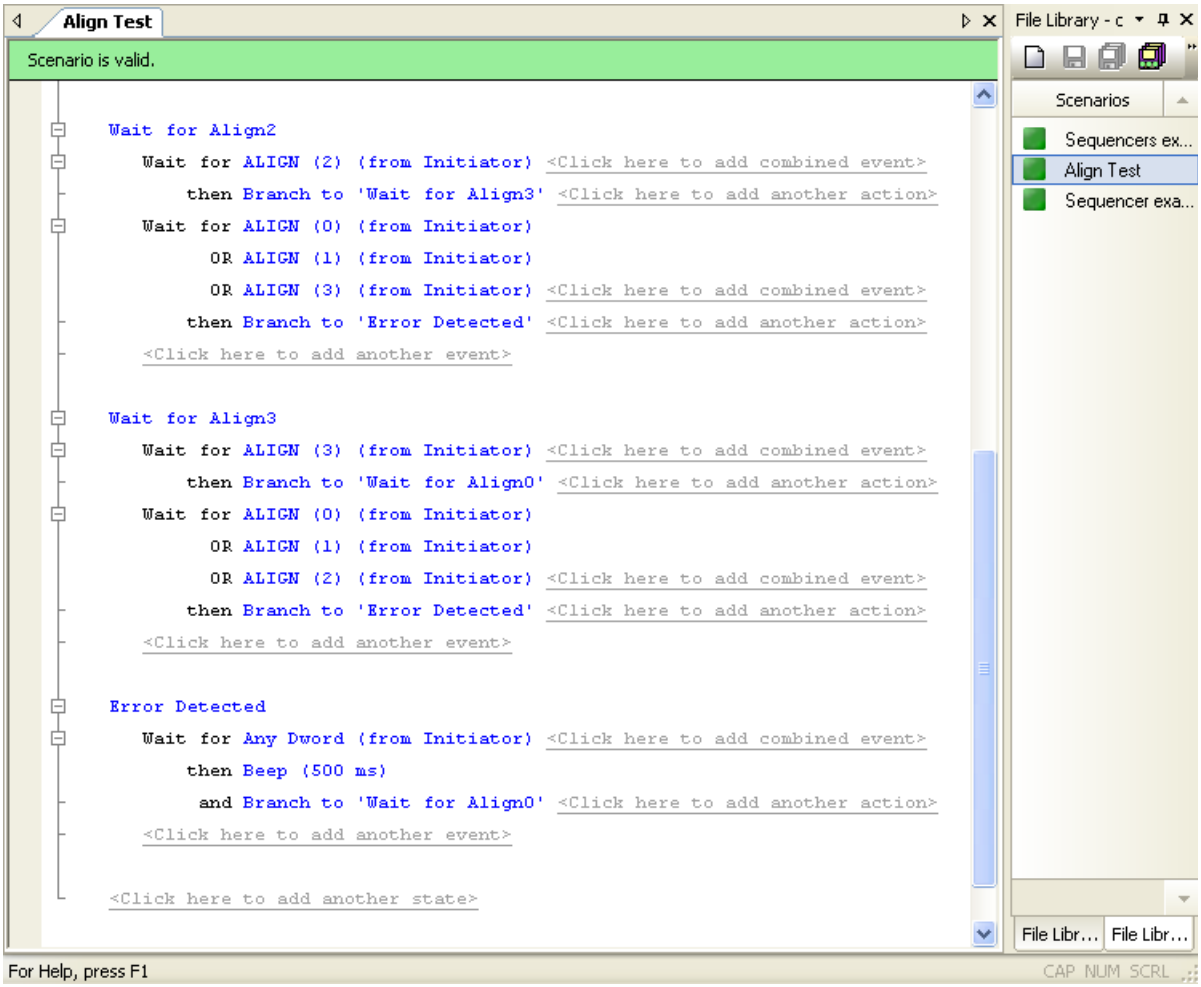


Figure 4.44: Example 8: Bottom Half of Scenario

4.12 Example 9: Creating a Sequence With Many States #2

In this example, a five-state sequence not only detects if a group of primitives is received out-of-order, but it fixes any incorrect order. The logic is similar to that of example 8 with a few small changes. The following table summarizes each state.

TABLE 4.12: Example 9: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1).
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2); otherwise, replace primitive with Align (1) and go to Indicate Error.
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, replace primitive with Align (2) and go to Indicate Error.
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise, replace primitive with Align (3) and go to Indicate Error.
Indicate Error	Indicate error and restart test.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the five states for this sequence.

3. In the File menu, select **Save Scenario** to save the scenario.

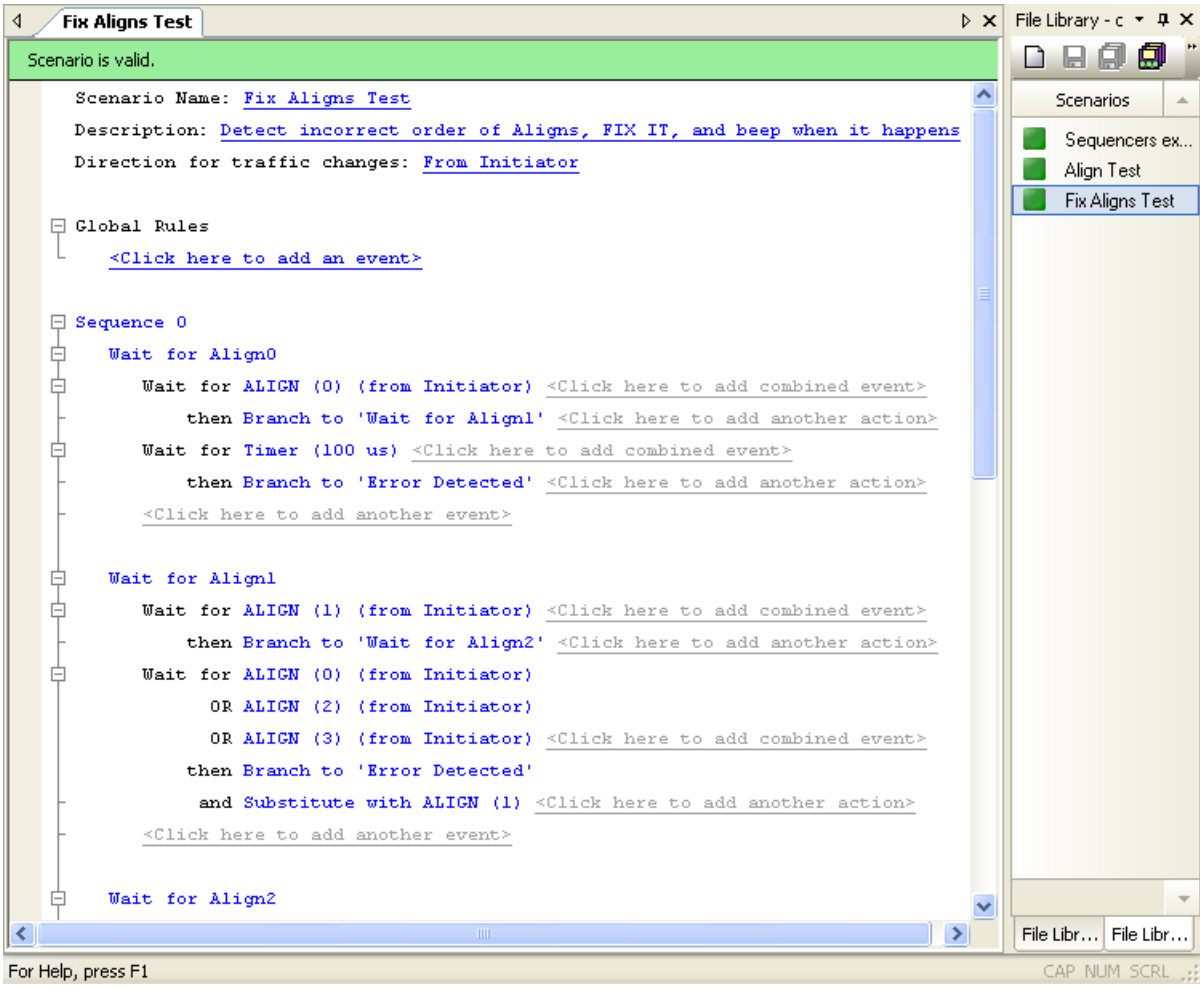


Figure 4.45: Example 9: Top Half of Scenario

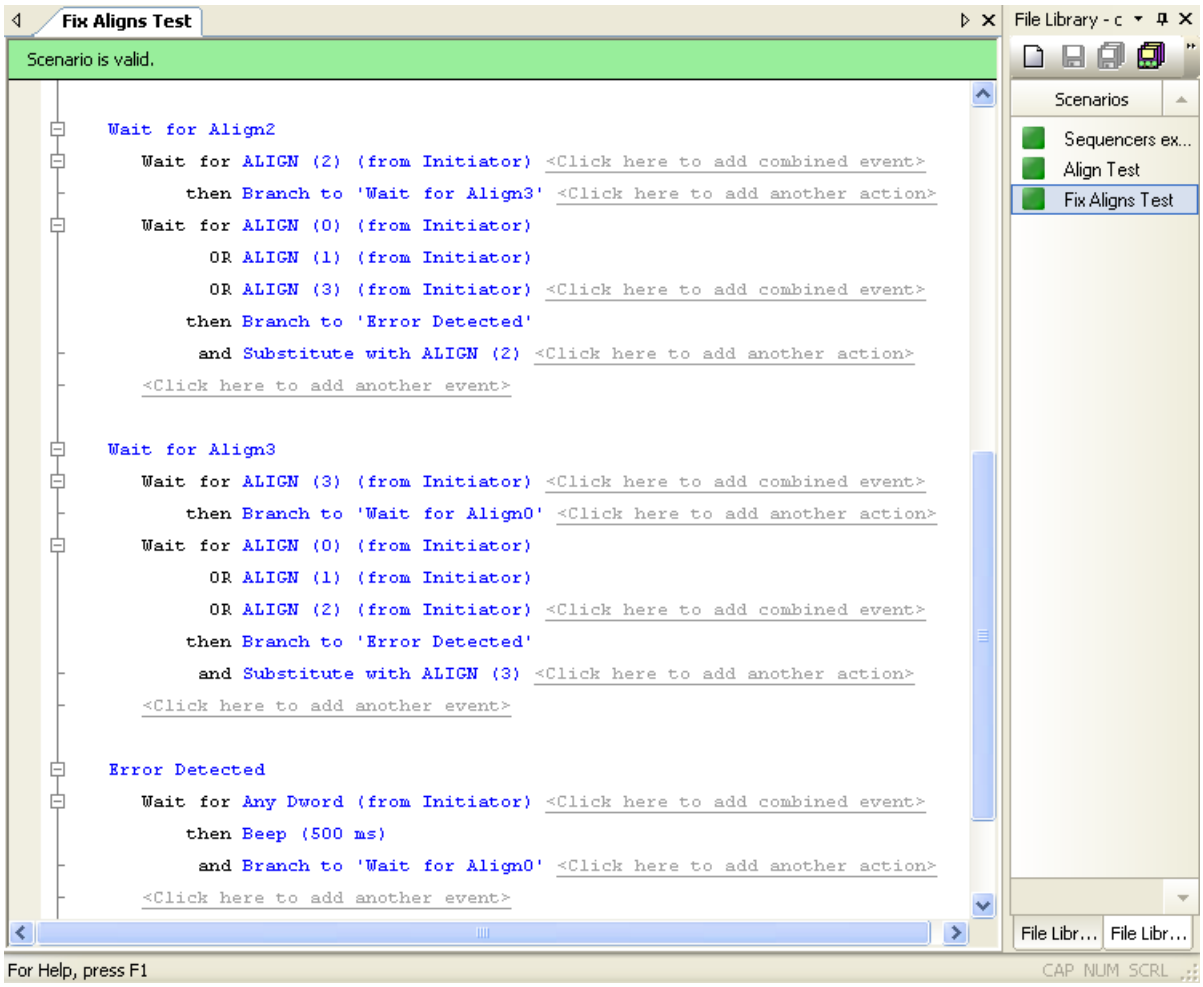


Figure 4.46: Example 9: Bottom Half of Scenario

4.13 Downloading Scenarios

After you have created a scenario, you need to download it to the InFusion device for execution.

If you use a general library as a scenario archive, then the process of creating and downloading a scenario is as follows:

1. Open the general library (Main library or a File library). Scenarios in the library are listed in the Main Library window.
2. Open the Device Library window by clicking the **Show Device Library** button on application toolbar.
3. Open the Device Library for the device to which you want to download a scenario or scenarios. You can open the device library in two ways: by clicking the **Device Library icon** in the device list window or by double-clicking the **device name**.
4. Copy the scenario from general library to device library by dragging it with the mouse.

5. Download all scenarios in the device library to the InFusion device. To do so, click the **Download all Scenarios** button on the Device Library toolbar (second button from left).

4.14 Running Scenarios

If you use a general library as a scenario archive, then the process of executing a scenario is as follows:

1. Select the scenario to run by clicking it.
2. To run the scenario, click the **Run Scenario** button on the Device Library toolbar (second button from the right). The InFusion device then begins its session.

4.15 Scenario Batch Files

You can write a script with commands to run a sequence of executable scenarios automatically. A Scenario Batch file is a text file with a list of commands to run in sequence when you execute the file. A batch script can manage scenarios and their assigned ports and hardware in sequence, using conditions. The system checks for accuracy of inputs and commands.

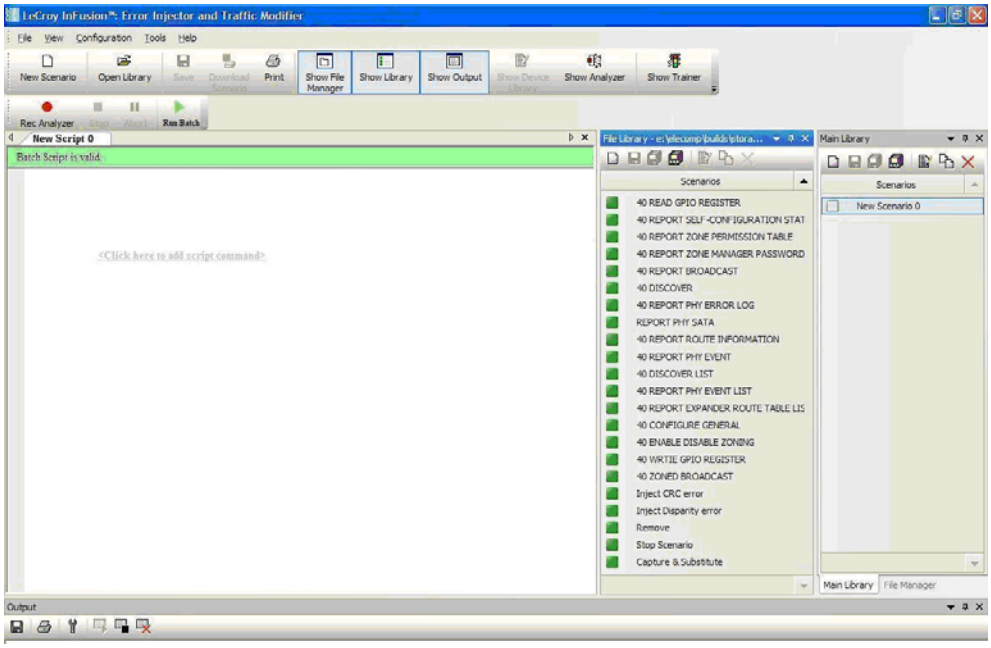
Note: Before you run a Scenario Batch file that requests scenarios, you must download the scenarios to the Scenarios box.

To start a batch script, click the **New Batch Script**

button or select **File > New Batch Script**.

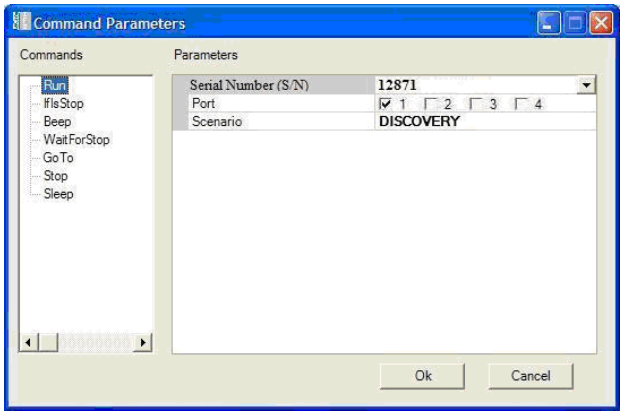
4.15.1 Script Workspace

In the Script Workspace (see the following figure), add a command and make a batch file.



In this window, you can enter a script command by clicking **Click here to add script command**.

1. Select **Click here to add script command** to open the Command Properties dialog.



The **Command Parameters** Dialog contains the list of available commands and their parameters from which to build scenarios and connected hardware and available ports.

2. Select appropriate parameters for the command and click **OK** to display the script in the Script Workspace.

Note: You can select ports from the port list, depending on number of ports licensed.

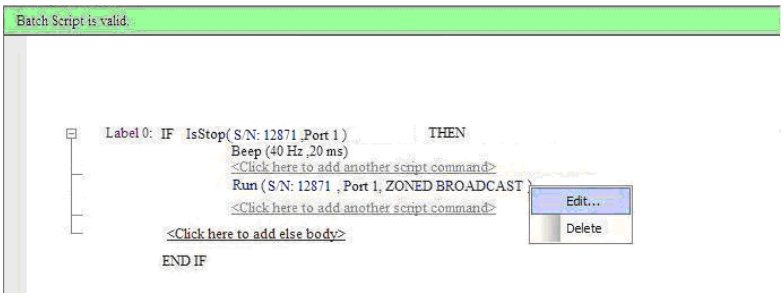
Note: The hardware Serial Number can already exist or not. If the Serial Number exists, the Serial Number (for example, S/N: 12871) is shown. In Offline and Simulation mode, you can enter a Serial Number. In Online mode, you can only enter an existing Serial Number.

3. To add another command, click **Click here to add another script command**.

To copy a script command, right-click on the command and select **Copy**.
Right-click **Click here to add another script command** and then select **Paste**.

You can also cut, delete, and edit a selected script command.

4. To edit batch commands, click the command, or right-click the command and select **Edit** from popup menu.



To delete a command, right-click and select **Delete** from popup menu, or select command and press **Delete** key on keyboard.

After finishing, if everything is correct, push the **Run Batch** button to execute scenario and save result in the log file.

Note: Before you run a Scenario Batch file that requests scenarios, you must download the scenarios to the Scenarios box.

4.15.2 Error Checking

The Script Workspace shows errors by red color. The program reports all errors in the log file.

If you use a script from other InFusion hardware, it may cause an error, for example, mismatch in hardware Mac addresses, or scenarios that are not already in current hardware.

4.15.3 Log

Results of executable batch commands are saved automatically into a log file with user-specified name. The status of executable commands is shown in log area.

4.15.4 Statements

Statements can be conditional statements or non-conditional statements.

IfIsStopped

Shows whether a scenario is already stopped or not.

Format

```
IfIsStopped (Serial Number, Target Port)
```

Parameters

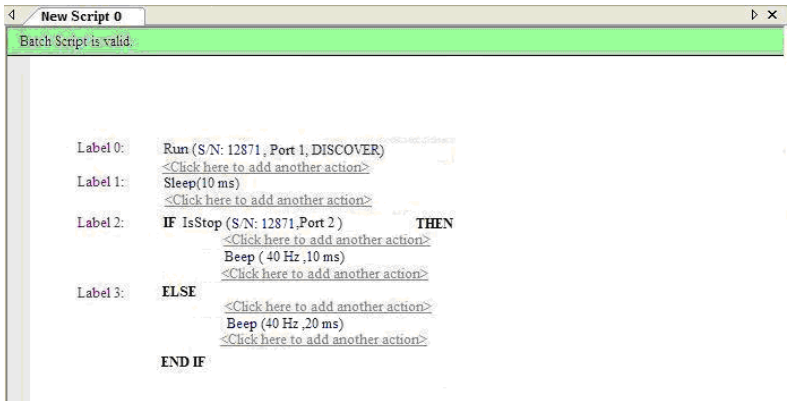
- **Serial Number**: Serial number of hardware
- **Target Port**: Port number in port map

Example

```
IfIsStopped(ox01267, 1) Then
  {
  Beep (750, 300)
  Run (ox01267," Detect AddressFrame Open", 5)
  }
```

The value of second parameter is 5 and shows check stopping mode of combination of port number 1 and port number 3.

After filling parameters from the Command Parameters Dialog, the program makes the IF-ELSE structure in the Script workspace. The ELSE statement is optional. To add an ELSE body, click **Click here to add else body**.



Goto Label

Goes to specified label. Labels can be assigned to each script line.

Format

```
Goto Label3
```

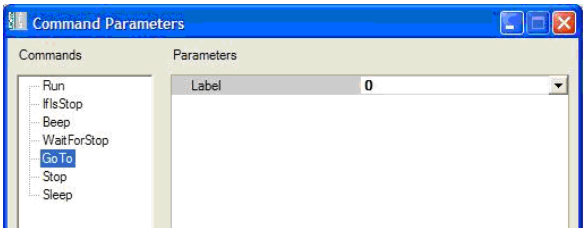
Parameters

None

Example

```
Label3: WaitForStop(0x83456, 2, 100))
Run (ox01267," Inject CRC000", 4)
Goto Label7
```

Note: You can use a **Label** and a **Goto Label** to make loops. First make the label, then make Goto Label. The Command Parameters window shows only enabled Labels. Labels are disabled by default and are in gray color. To enable them, click them to make purple color.



Run

Runs the scenario on hardware on specified ports. If you call this command for the first time and the scenario was not assigned to the hardware and ports before, the scenario is assigned to specified hardware and ports and then scenario runs on the hardware.

Format

```
Run(Serial Number, Scenario Name, Target Port)
```

Parameters

- **Serial Number**: Serial number of hardware
- **Scenario Name**: Name of scenario
- **Target Port**: Port number in port map

Example

```
Run (ox841200," Substitute address frame", 4)
Beep(800, 400)
Run (ox841200," CRC Inject _ Play CD", 8)
WaitForStop(0x63463, 1, 150)
Run (ox841200," Remove Send Cue Sheet", 2)
Goto Label6
Run (S/N: 12871, Port 1, DISCOVER)
```

Note: If the selected ports are busy, scenario cannot run, and the command will be skipped. The result will be written in Log area.

Stop

Stops running scenario by hardware and port name.

Format

```
Stop (Serial Number, Target Port)
```

Parameters

Serial Number: Serial number of hardware

Target Port: Port number in port map

Example

```
Run (ox00820,"Inject CRC000", 2)
Beep(700, 500)
Stop (ox00820, 2)
Goto Label3
...
Label3 : Run(ox005007,"Detect DATA", 8)
Sleep(40)
```

WaitForStop

Used to wait for occurrence of specified condition.

Format

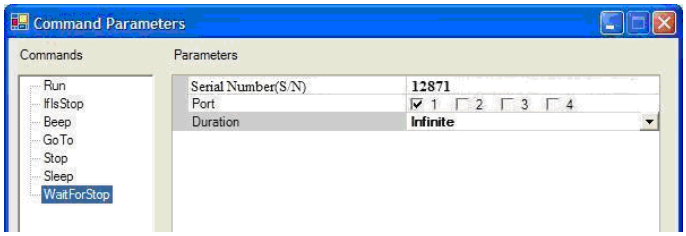
```
WaitForStop(SerialNumber, Target Port, Duration)
```

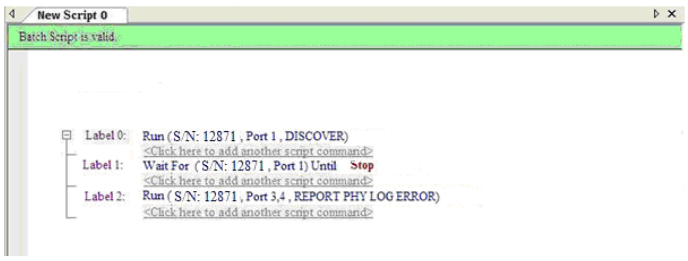
Parameters

- **Serial Number**: Serial number of hardware
- **Target Port**: Port number in port map
- **Duration**: Integer or random duration in milliseconds. In the Command Parameters Window, WaitForStop duration has three options:
- **Infinite**: Wait until **Stop** command.
- **Random**: Stop after a random time.
- **Finite time**: Stop after specified time in milliseconds.

Example

```
Run (ox001267,"Detect AddressFrame Open", 2)
WaitForStop (0x348790, 2, Forever)
Run (ox005007,"Detect DATA", 4)
WaitForStop(ox005007, 4, 100)
Stop (ox001267, 2)
```





Sleep

Used to sleep for a few seconds.

Format

```
Sleep(Duration)
```

Parameters

- **Duration**: Integer or random duration in milliseconds

Example

```
Sleep(100)
```

Beep

If specified condition is satisfied, the system beep for specified duration.

Format

```
Beep (Duration, Frequency)
```

Parameters

- **Duration**: Integer or random duration in milliseconds
- **Frequency**: Frequency in hertz

Example

```
IfIsStopped(0x83456, 4)) then
  {
  Beep (2, 20)
  Run (0x83456,"Identify_Disparity error", 8)
  }
```

Chapter 5

Sierra Trainer Traffic Generation

The Sierra Trainer is a traffic generator that can emulate a SAS initiator/target or SATA host/device. Traffic generation enables engineers to test designs under realistic conditions and to transmit known errors, allowing engineers to observe how devices handle faulty link conditions.

Traffic generation is performed via the execution of text-based scripts. These traffic generation files (***.ssg**) contain statements about the types of traffic to be generated. These script files can be edited with either a simple text editor such as Notepad or with the Script Editor utility provided by the application.

To open the Traffic Generation window, click the **Launch Trainer Icon**

in the SAS Protocol Suite or SATA Protocol Suite window.

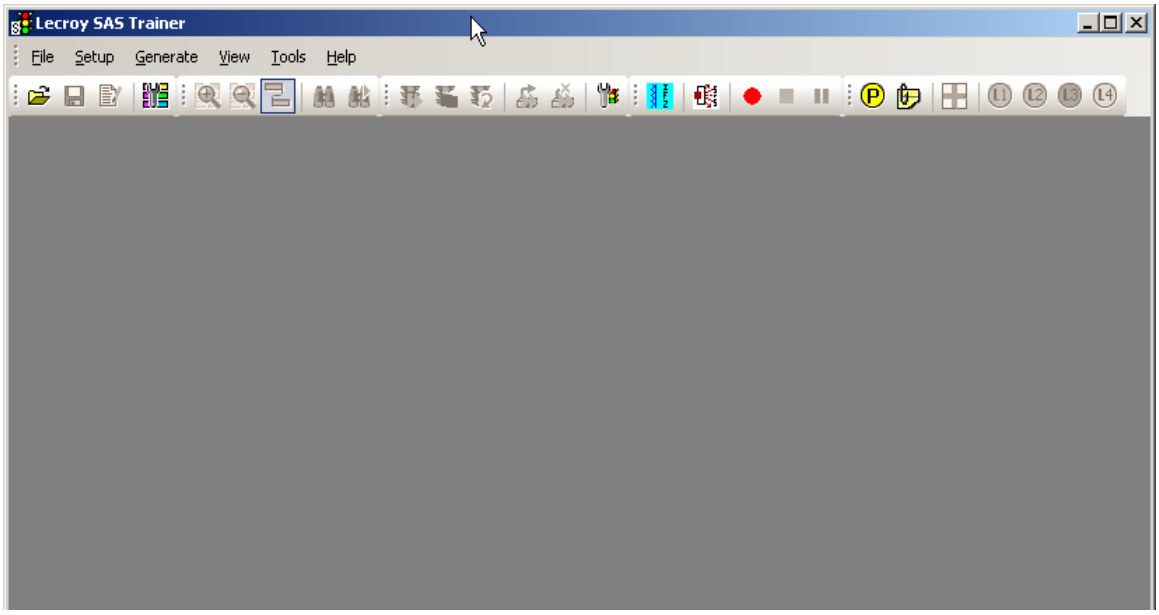


Figure 5.1: Sierra Trainer Window

5.1 Sierra Trainer Menus

The Sierra Trainer menus are:

5.1.1 File Menu

New GenFile: Starts a new Generation File.

Open: Opens a file.

Close: Closes the current window.

Launch Analyzer: Displays Analyzer Window.

Launch Jammer: Displays Jammer (Infusion) Window.

Save As: Saves the current file with a new name.

Print: Prints part or all of the current traffic data file.

Print Preview: Produces an on-screen preview before printing.

Print Setup: Sets the options for the current or new printer.

Edit Comment: Allows you to enter a comment in a dialog.

Export: Saves trace as text file in Packet View Format.

Convert: Converts an SATrainer Generation File (**.stg** file) to a Generation File (**.ssg** file).

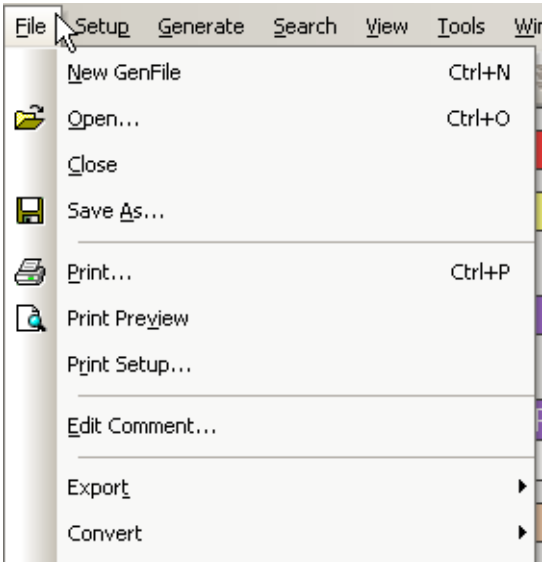


Figure 5.2: Trainer File Menu

5.1.2 Setup Menu

- Update Sierra Device: See “Update Device” on page 307.
- **Port Configuration**:

You can select different combinations of Trainer with Analyzer and Jammer. When running two different applications on the ports, you must set the same port configuration in both of them. See “Ports Configuration” on page 106. The following describes possible configurations:

- **Analyzer and Trainer on same port**: You can generate initiator/target traffic and also capture the traffic generated.

- **Analyzer and Trainer on same port, and Analyzer and Trainer on another port**: You can generate initiator/target traffic and also capture the traffic generated on two ports.
- **Trainer on one port, and Analyzer on another port**: Trainer is run on a port generating initiator/target traffic and Analyzer is run on the other port capturing the traffic.
- **Trainer and Jammer on same port**: You can generate initiator/target traffic and also inject errors on the traffic between initiator and target on the port.

Note: See "Multi-Port Trainer Script Assignments to Links" on page 406.

Display Options: Selects what information to display. See "Display Options" on page 459.

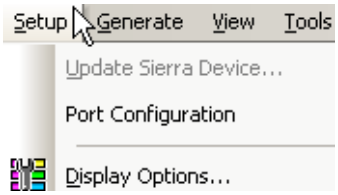


Figure 5.3: Trainer Setup Menu

5.1.3 Generate Menu

Start Generation: Causes the Generator to begin generation.

Stop Generation: Causes the Generator to stop generation.

Resume Generation: Causes the Generator to resume generation after a stop.

Connect Link: Automatically bring the linkup to the Host, Device, Initiator, or Target connected to the Generator.

Disconnect Link: Disconnect link.

Connect Parameters: Set the "Identify" frame parameter settings to keep the link connected. See "Connection Parameters" on page 464.

Generation Options: Setup the Generation Rules. See "Generation Options" on page 447.

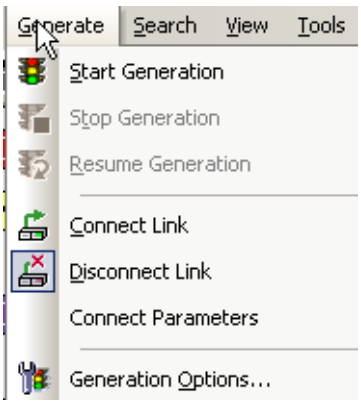


Figure 5.4: Trainer Generate Menu

5.1.4 Search Menu

Go to Event: Opens a dialog that allows you to go to a frame and time.

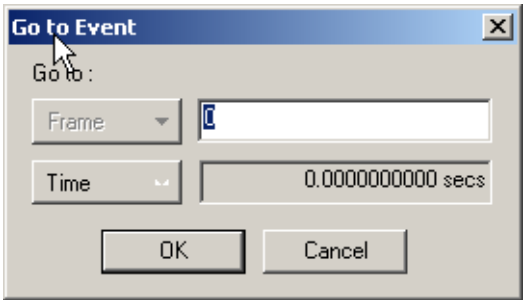


Figure 5.5: Go to Event Dialog

Go to Marker: Positions the display to the selected marked packet.

Go to: Packet Types, SSP Frames, SMP Frames, Primitives, Errors, Data Lengths, Speed, SATA FIS Type, SATA FIS Port, or Hash Address (Source or Destination).

Find: Displays the Find dialog. See “Find” on page 455.

Find Next: Applies the previous **Find** parameters to the next search.

Search Direction: Toggles the search forward or backwards. The current direction is indicated in the menu.

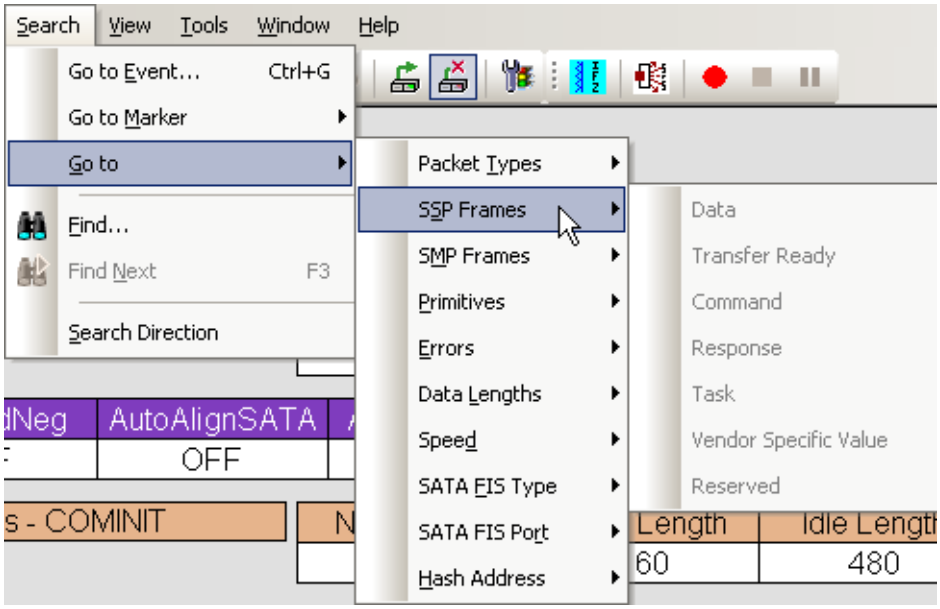


Figure 5.6: Trainer Search Menu

5.1.5 View Menu

Zoom In: Increases the size of the displayed elements.

Zoom Out: Decreases the size of the displayed elements.

Toolbars: Displays list of available toolbars: Standard, Frequently Used, Generator, Analyzer, Ports, or Customize. See "Resetting the Toolbar" on page 465.

Status Bar: Toggles the Sierra Trainer Status Bar, at the bottom of the window, which shows help messages and the search direction. The right most segment displays the current search direction: Fwd (forward) or Bwd (backward). Change the search direction from the Search menu or double-click the Search Status segment.

Wrap: Wraps displayed packets within the window.

Compact: Displays each row on one line only, with no wrapping.

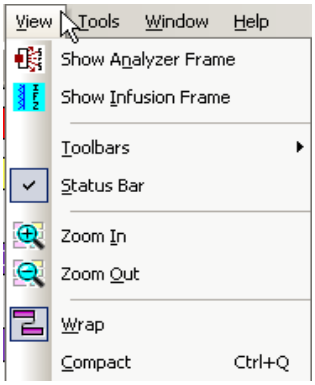


Figure 5.7: Trainer View Menu

5.1.6 Tools Menu

Hash Address Utility: Opens a dialog that allows you to enter an eight-byte SAS Address to display a Hashed Address.

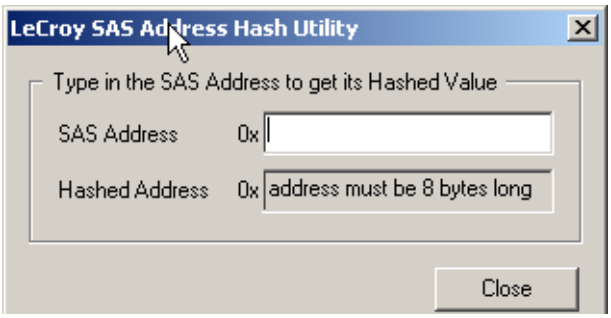


Figure 5.8: Address Hash Utility Dialog

5.1.7 Window Menu

Cascade: Displays all open windows in an overlapping arrangement.

Tile Horizontal: Displays all open windows in a above-below arrangement.

Tile Vertical: Displays all open windows in a side-by-side arrangement.

Arrange Icons: Arranges minimized windows at the bottom of the display.

Windows: Displays a list of open windows.

5.1.8 Help Menu

Help Topics: Displays online help. You can also select F1.

Check for Updates: Check whether a new software version is available. If so, you can download from the Teledyne LeCroy web site. You can select to Check for updates at application startup.

About: Displays version information.

5.2 Sierra Trainer Main Toolbar

The Sierra Trainer toolbar contains the following buttons:

Figure 5.9: Sierra Trainer Toolbar

The buttons have the following functions:

	Open Document.		Save As. Opens a dialog in which you can save your edits in the appropriate file type.
	Edit as Text. Edit the text file for the document.		Setup Display Options. Opens the Display Options window.
	Zoom In.		Zoom Out.
	Wrap.		Find.
	Find Next.		Start All Generation.
	Stop All Generation.		Resume All Generation.
	Connect All Link.		Disconnect All Link.
	Setup Generation Options. Opens the Generation Options window.		Launch Jammer (Infusion).
	Launch Analyzer.		Start Recording.
	Stop Recording.		Abort Recording.
	Show Port Configuration Dialog. (See “Ports Configuration” on page 108.)		Show Script Assignment Dialog. (See section below.)

	Tile Windows		Assign Active Script/ Remove Assigned Script for Link 1, 2, 3, or 4 See “Multi-Port Trainer Script Assignments to Links” on page 406.

5.3 Setting Up for Generating Initiator Traffic

Connect the SAS cable from the **Target** port of the Sierra Analyzer to the Target port on the unit under test. This transmits the Traffic Generator stream from the **Target** port to the target-side port on the unit under test.

5.4 Setting Up for Generating Target Traffic

Connect the SAS cable from the **Initiator** port of the Sierra Analyzer to the Initiator-side port on the unit under test. This transmits the Traffic Generator stream from the **Initiator** port to the initiator-side port on the unit under test.

5.5 Creating a Traffic Generation File

Generating traffic is a two-step process.

First, create a text-based Sierra Trainer Traffic Generator file. This text file has an **.ssg** extension. You can create this file by creating a new generator file or editing an existing file.

Note: **ssg** files created in other applications run in the Sierra Trainer.

After the file has been created, it can be opened and displayed in the application. You can invoke the application to transmit the traffic generation file by using the **Start Generation** button .

Note: For details about traffic generation files, see “Sierra Trainer Generation Language” on page 408.

5.5.1 Creating a New Generator File

You can create a new Sierra Trainer Traffic Generator **.ssg** file.

To create an .**ssg** file:

1. In the Sierra Trainer window, select **File > New GenFile** to display the Global Settings of a new **.ssg** file in a trace view (see Figure 5.10 on page 394).

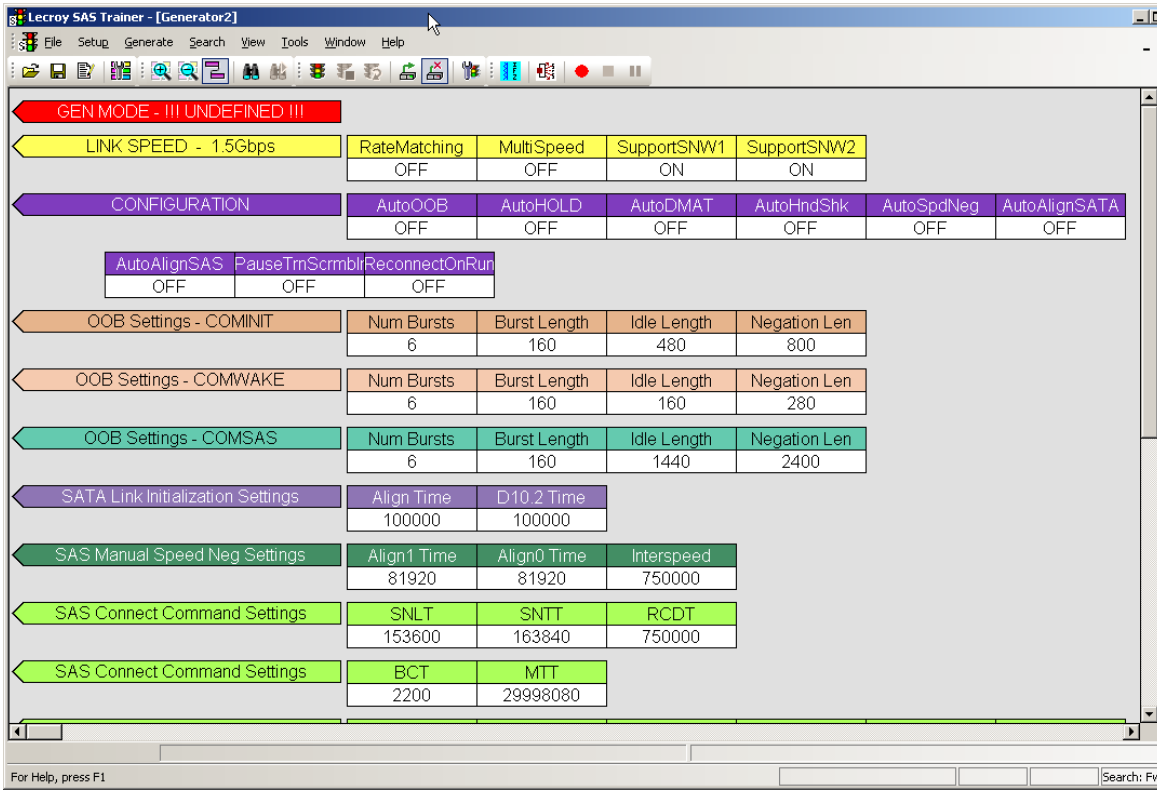

Lecroy SAS Trainer - [Generator2]
File Setup Generate Search View Tools Window Help
GEN MODE - !!! UNDEFINED !!!
LINK SPEED - 1.5Gbps
RateMatching MultiSpeed SupportSNW1 SupportSNW2
OFF OFF ON ON
CONFIGURATION
AutoOOB AutoHOLD AutoDMAT AutoHndShk AutoSpdNeg AutoAlignSATA
OFF OFF OFF OFF OFF OFF
AutoAlignSAS PauseTrnScrmblr ReconnectOnRun
OFF OFF OFF
OOB Settings - COMINIT
Num Bursts Burst Length Idle Length Negation Len
6 160 480 800
OOB Settings - COMWAKE
Num Bursts Burst Length Idle Length Negation Len
6 160 160 280
OOB Settings - COMSAS
Num Bursts Burst Length Idle Length Negation Len
6 160 1440 2400
SATA Link Initialization Settings
Align Time D10.2 Time
100000 100000
SAS Manual Speed Neg Settings
Align1 Time Align0 Time Interspeed
81920 81920 750000
SAS Connect Command Settings
SNLT SNTT RCDT
153600 163840 750000
SAS Connect Command Settings
BCT MTT
2200 29998080
For Help, press F1

Figure 5.10: New GenFile

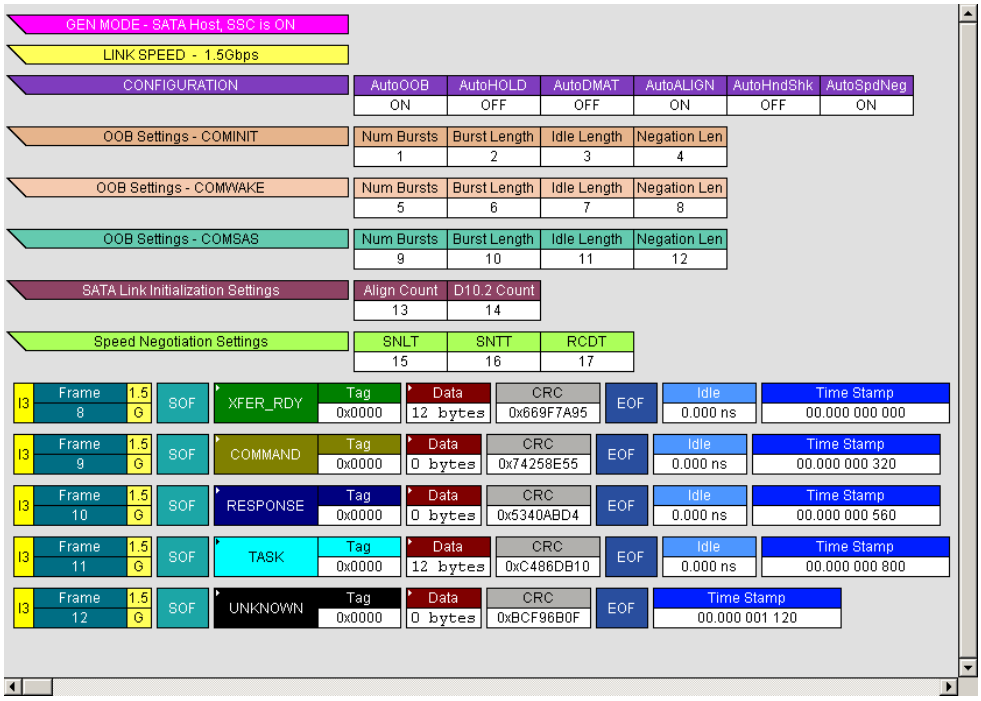
2. Click the **Edit as Text** button to enter a Generation Block or Change Settings instructions in the Script Editor. See “Starting the Script Editor” on page 402.

5.5.2 Editing an Example Generation File

The easiest way to generate traffic is to start with one of the example generation files and edit the settings to see how the script file behaves. As you make and save changes, the trace view of the generation file is automatically updated.

The following screenshots show an example file as it appears in the script editor and trace window.

```
%include "Generation\Include\SSPFramesDecl.inc"

Generation
{
   # SendSSPFrameData
   # {
   #     Data = { 21223344 55667788 99AABBCC }
   # }

    SendSSPFrameXferRdy
    {
        Data = { 51223344 55667788 99AABBCC }
    }

    SendSSPFrameCommand

    SendSSPFrameResponse

    SendSSPFrameTask
    {
        Data = { 51223344 55667788 99AABBCC }
    }

    SendSSPFrameVendor
}
```


GEN MODE - SATA Host, SSC is ON
LINK SPEED - 1.5Gbps
CONFIGURATION
AutoOOB AutoHOLD AutoDMAT AutoALIGN AutoHndShk AutoSpdNeg
ON OFF OFF ON OFF ON
OOB Settings - COMINIT
Num Bursts Burst Length Idle Length Negation Len
1 2 3 4
OOB Settings - COMWAKE
Num Bursts Burst Length Idle Length Negation Len
5 6 7 8
OOB Settings - COMSAS
Num Bursts Burst Length Idle Length Negation Len
9 10 11 12
SATA Link Initialization Settings
Align Count D10.2 Count
13 14
Speed Negotiation Settings
SNLT SNTT RCDT
15 16 17
I3 Frame 8 1.5 G SOF XFER_RDY Tag 0x0000 Data 12 bytes CRC 0x669F7A95 EOF Idle 0.000 ns Time Stamp 00.000 000 000
I3 Frame 9 1.5 G SOF COMMAND Tag 0x0000 Data 0 bytes CRC 0x74258E55 EOF Idle 0.000 ns Time Stamp 00.000 000 320
I3 Frame 10 1.5 G SOF RESPONSE Tag 0x0000 Data 0 bytes CRC 0x5340ABD4 EOF Idle 0.000 ns Time Stamp 00.000 000 560
I3 Frame 11 1.5 G SOF TASK Tag 0x0000 Data 12 bytes CRC 0xC486DB10 EOF Idle 0.000 ns Time Stamp 00.000 000 800
I3 Frame 12 1.5 G SOF UNKNOWN Tag 0x0000 Data 0 bytes CRC 0xBCF96B0F EOF Time Stamp 00.000 001 120

In the screenshot, global settings make up the eight bars at the top of the window. Below that are five frames. If you look at the script itself, there are six frame commands, five active and one commented out.

The following sections describe how to open and edit traffic generation files.

5.5.3 Converting an SATrainer Traffic Generation File

If you have old 2500-based SATrainer Generator **.stg** files (previously used with CATC Tracer/Exerciser Model120K), you can convert them to Sierra Trainer Traffic Generator **.ssg** files using the legacy **Convert** function.

Perform the following steps to convert an **.stg** file into an .**ssg** file:

1. In the Sierra Trainer window, select **File > Convert > Convert .stg to .ssg** to display an Open dialog.
2. Use Files of Type **SATrainer Generator Files (.stg).**
3. Select an SATrainer Generator ***.stg** file.
4. Click **Open**. The application creates a Sierra Trainer Traffic Generator file (***.ssg**).

Note: SATrainer Generator Files (.stg) are for the CATC Tracer Exerciser model 10K.

5.6 Opening a Traffic Generation File

After the Traffic Generator file (***.ssg)** file has been created, you can open it in the application.

To open a Traffic Generator file:

1. Select **File > Open** on the Menu Bar, or click on the Toolbar, to display an Open dialog.
2. Select a Generator text file (***.ssg**) and click **Open** to display the file. (The install directory contains example files.)

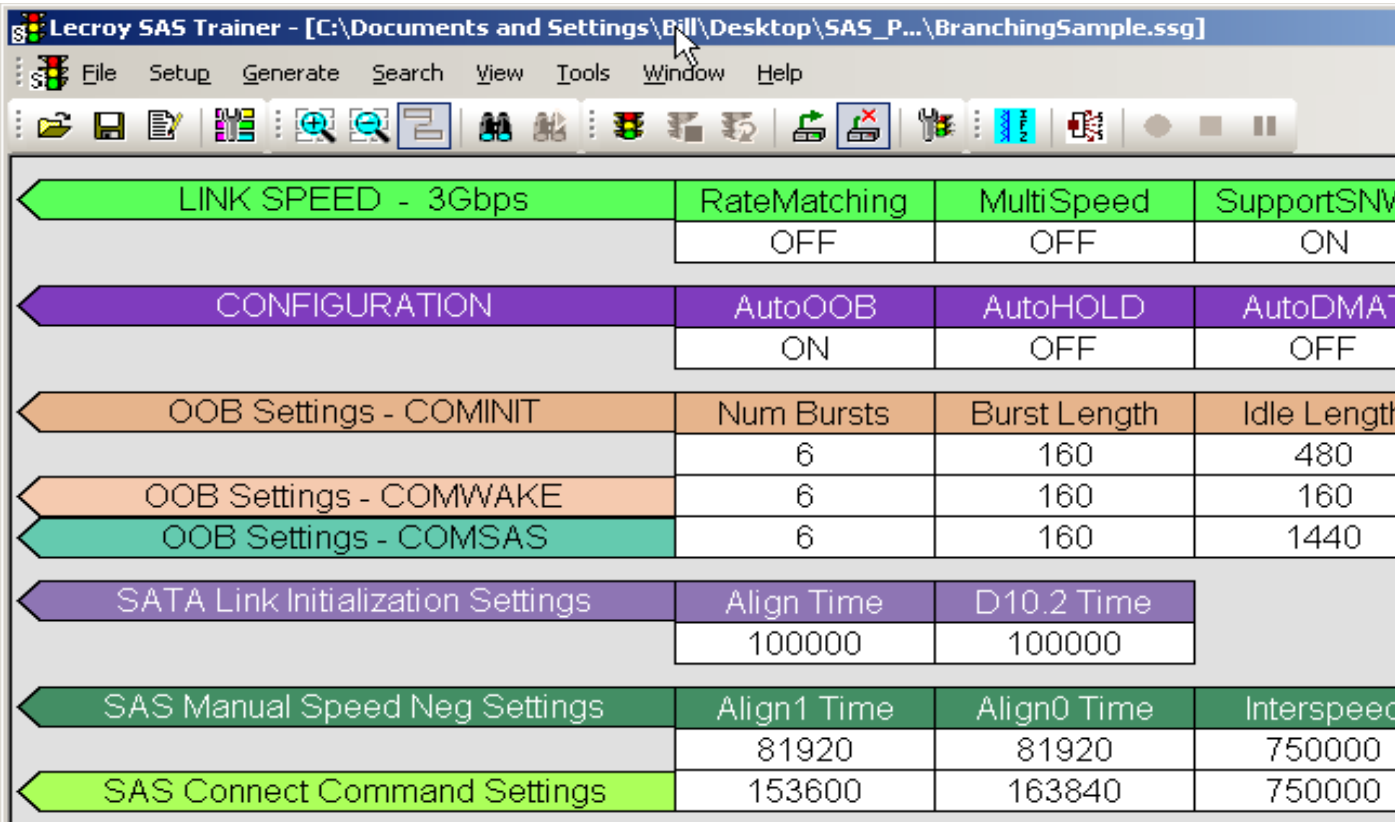


Figure 5.11: Sierra Trainer Generator File

5.6.1 Layout

The **.ssg** file has several colored bars that represent global settings. The bars show the current configuration of the generation file. Example settings are:

- Configuration
- GenMode (SAS or SATA, SSC On or Off)
- Link speed (1.5 Gbps, 3.0 Gbps, or 6.0 Gbps)
- Type of device (Initiator or Device)
- COMINIT
- COMWAKE
- Scrambling Mode

As changes are made and saved to the traffic generation file, the bars immediately update. The traffic pattern to generate appears below the bars as a series of frames. You can edit the traffic generation file to add, edit or remove frames.

5.7 Overview of Generation and Global Settings Files

Example **.ssg** files and **Include** files are in two directories called **\Samples** and **\Include** that are typically installed in: **C:\Program Files\LeCroy\SAS Protocol Suite\Generation**.

5.7.1 Traffic Generation (*.ssg) Files

The .**ssg** traffic generation files are text files consisting of **include** statements, a generation block, and optionally global statements.

The generation block is the code responsible for the actual traffic generation. It is marked by the tag **Generation**. The composition and format of the generation block is described later.

```
%include "Generation\Include\Settings.inc"

Generation
{

}
```

The **include** statements provide links to the **Include** files, which provide the definitions for primitives, frames, and settings that hold for most or all of the generation session (global settings).

The definitions for SAS and SATA traffic are contained in Teledyne LeCroy-provided **Include** files: Settings.inc, PrimitivesDecl.inc, AddressFramesDecl.inc, SSPFrames.inc, SMPFrames.inc, and SSPFrames.inc.

5.7.2 Settings.inc File

The **Settings.inc** file contains global statements about the link, the type of device being emulated, and other conditions that are to exist throughout part or all of the traffic generation. This file must be included in the traffic generation file.

There are fifteen groups of settings in this file:

- AutoMode
- COMINIT/COMRESET OOB Signal
- COMWAKE OOB Signal
- COMSAS OOB Signal
- Generation Commands
- Link Speed
- SATA Link Initialization
- SAS Speed Negotiation
- SATA Speed Negotiation
- Autowait:
  - SAS After
  - SAS Before
  - SATA After
  - SATA Before
- Wait Command Timeout
- Scrambling Mode

Details about each group of settings are described in the **Traffic Generation Language** section.

Editing Settings.inc

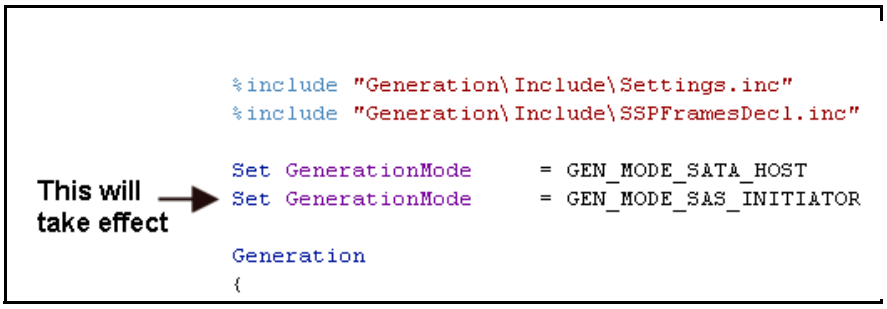
Text in the **Settings.inc** file can be edited directly or copied into the beginning of the traffic generation file and edited there.

```
%include "Generation\Include\PrimitivesDecl.inc"
%include "Generation\Include\Settings.inc"

Set GenerationMode = GEN_MODE_SATA_HOST

Generation
{

}
```

When editing global settings, keep in mind the following rule: The last line encountered before the generation block takes precedence. Thus, if the following two lines about the device emulation were added just above the generation block, the second would take effect:

set GenerationMode = GEN_MODE_SATA_HOST

set GenerationMode = GEN_MODE_SAS_INITIATOR



5.7.3 The Global Setting “AutoAlign”

AutoAlign is a global setting that may be on or off depending on the type of device you are emulating. There is an AutoAlign setting for SAS and one for SATA, for example, “set AutoAlignSAS = ON” and “set AutoAlignSATA=OFF.”

- SAS: Sends AutoAligns every 2048 DWORDs.
- SATA: Sends AutoAligns every 256 DWORDs.

If you plan to set and reset AutoAlign in the middle of traffic generation, you need to know what the defaults are for AutoAlign. The defaults are as follows:

For SATA host/device emulation,:

- AutoAlignSATA is assumed to be ON.
- AutoAlignSAS is assumed to be OFF.

For SAS emulation, the assumptions are opposite:

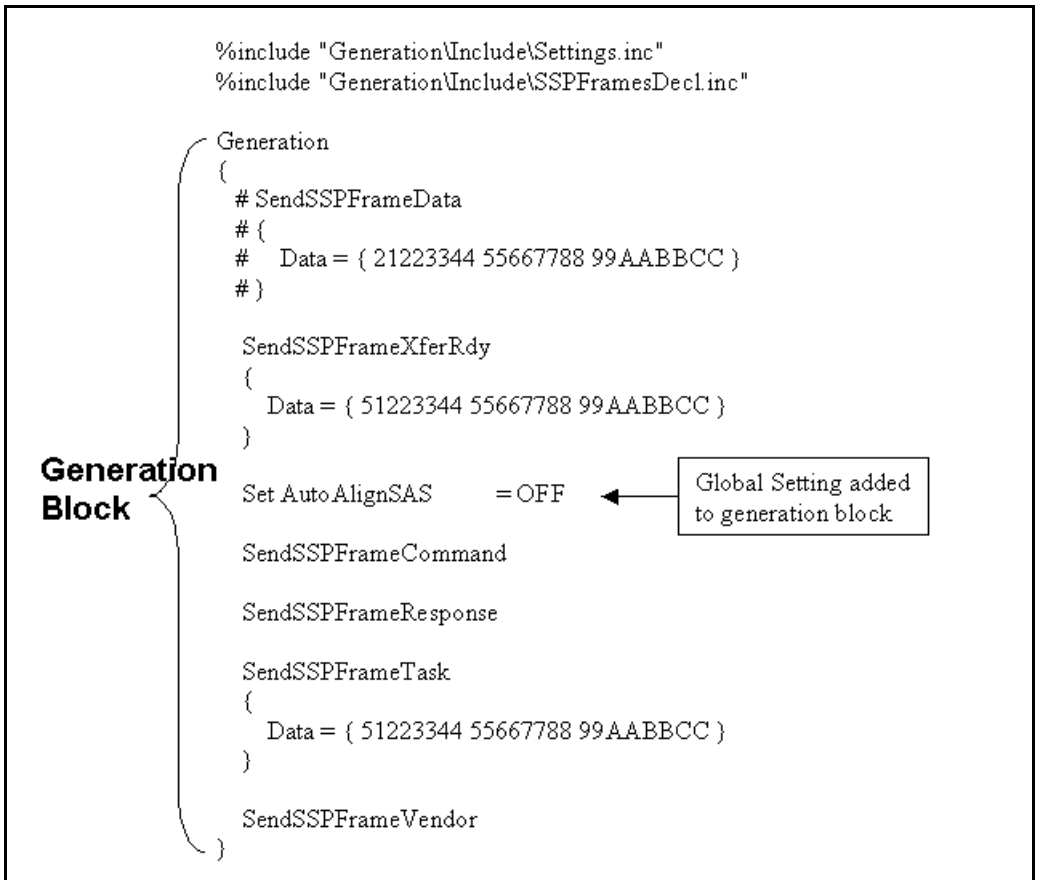
- AutoAlignSATA is assumed to be OFF.
- AutoAlignSAS is assumed to be ON.

For STP:

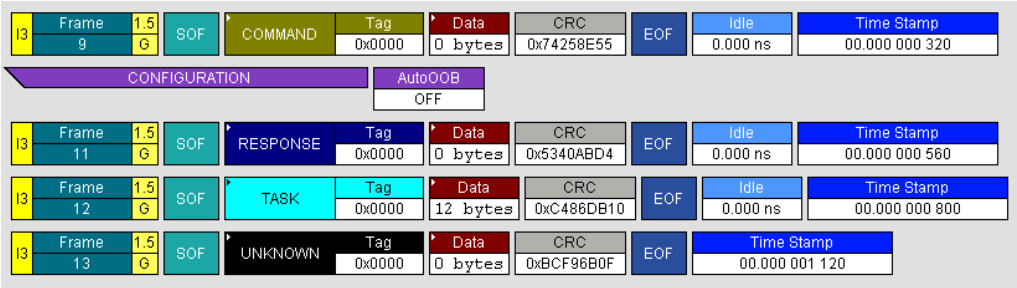
- AutoAlignSAS and AutoAlignSATA are assumed to be ON.

5.7.4 Placing Global Settings in the Generation Block

Some global settings such as AutoAlign = On/Off can be set and reset in the generation block. For example, you might want to set SASAutoAlign = ON prior to traffic generation, and then change to OFF halfway through the generation session.



When placed within the generation block and then viewed in the trace window, global settings appear as colored bars interspersed amidst the traffic.


I3 Frame 9 1.5 G SOF COMMAND Tag 0x0000 Data 0 bytes CRC 0x74258E55 EOF Idle 0.000 ns Time Stamp 00.000 000 320
CONFIGURATION AutoOOB OFF
I3 Frame 11 1.5 G SOF RESPONSE Tag 0x0000 Data 0 bytes CRC 0x5340ABD4 EOF Idle 0.000 ns Time Stamp 00.000 000 560
I3 Frame 12 1.5 G SOF TASK Tag 0x0000 Data 12 bytes CRC 0xC486DB10 EOF Idle 0.000 ns Time Stamp 00.000 000 800
I3 Frame 13 1.5 G SOF UNKNOWN Tag 0x0000 Data 0 bytes CRC 0xBCF96B0F EOF Time Stamp 00.000 001 120

While most global settings can be set in the generation block, three will be ignored if placed within the generation block:
set Link Speed =
set GenerationMode =
set SSC =

These commands should be configured either in the **Setting.inc** file or at the beginning of the traffic generation file as a global statement.

5.8 Primitive and Frame Definitions

Five other **Include** files are provided that define the most of the known templates for Primitives and Frames. The five are:

- PrimitivesDecl.inc
- AddressFramesDecl.inc
- SSPFramesDecl.inc
- SMPFramesDecl.inc
- STPFramesDecl.inc

Each of the Frame templates defines header and field structure.

The default value for all Frame fields is zero.

5.8.1 Special Conditions for Frames

There are three conditions about Frames that need to be kept in mind when configuring Frame generation:

1. **Frame delimiters need to agree** - At the present time, when defining a Frame, make sure that the Frame Prologue and Frame Epilogue agree. Do not mix types. For example, do not mix a SAS Start of Frame (SOF) with a SAS End of Address Frame (EOAF).

   A SAS SOF should be matched to a SAS EOF. A SAS SOAF should be matched to a SAS EOAF. If generating SATA traffic, a SATA_SOF should be matched to a SATA_EOF.

   At the present time, if you mix different types of prologues and epilogues for any given Frame, the Frame is ignored.

2. **Data Length Fields can be fixed-length or variable** - By default, data frames are of a fixed length. If you want to generate variable length frames, place an asterisk in the Data definition field in the **SSPFramesDecl.inc** file:
   Data : *

```
39
40      ############# DATA ###############
41      Data                        : *     # Variable length field, can be assigned to an array of DWORDs
42
43
```

If you replace the asterisk with a value, then the field becomes fixed length.

3. **CRC Calculations are calculated unless told otherwise** - If the CRC is not explicitly set in the traffic generation file, the application assumes that you want it and calculates and displays it in front of the generated frames.

   If you provide a CRC value, the application uses that value, even if it is incorrect. This gives you the option of configuring the generator to create errors.

If the generation file was created through the Export command (File > Export > To Generator File Format ...), the CRC is calculated but commented out. If the source trace has a bad CRC, the CRC is exported into the generation file and is not commented out.

5.8.2 Primitives Decl.inc File

The **PrimitivesDecl**.inc file defines Primitives. The file consists of declarations (left) and the corresponding byte streams (right).

```
 6   Primitive SOAF                                    = kBC 18 1E 81
 7   Primitive EOAF                                    = kBC 18 67 9F
 8
 9   Primitive "ALIGN (0)"                             = kBC 4A 4A 7B
10   Primitive "ALIGN (1)"                             = kBC 07 07 07
11   Primitive "ALIGN (2)"                             = kBC 61 61 61
12   Primitive "ALIGN (3)"                             = kBC 7B 7B 7B
```

To generate Primitives, copy relevant portions of text on the left (not the bytes shown right) from this file into the generator block section of the **.ssg** file.

5.8.3 Address FramesDecl.inc File

The **AddressFramesDecl**.inc file defines Address frames.

5.8.4 SSPFrames.inc File

The **SSPFrames.inc** file defines SSP frames.

5.8.5 SMPFrames.inc File

The **SMPFrames.inc** file defines SMP frames.

5.8.6 STPFrames.inc File

The **STPFrames.inc** file defines STP frames.

5.9 Starting the Script Editor

To edit an **.ssg** file, use the Script Editor. The Script Edit editing tool displays the **.ssg** file and its supporting **Include** files. The Script Editor utility has several aids to simplify the process of writing and editing scripts: tool-tips, drop-down menus, and colored fields. The Script Editor example below shows several commented lines followed by some instructions. The Script Editor has three areas: toolbar (top), script window, and file tabs (at the bottom of the window). If errors occur, a log opens at the bottom of the window. **Note**: If more than one port of Trainer is licensed, you can assign scripts to one or more ports. See “Multi-Port Trainer Script Assignments to Links” on page 406.

To launch the Script Editor, click the **Script Editor** button on the toolbar or right-click in the trace window and choose **Edit as Text**.

Figure 5.12: Script Editor

5.9.1 Script Editor Toolbar

The Script Editor toolbar contains buttons for saving your edits, navigating, searching, and other functions.

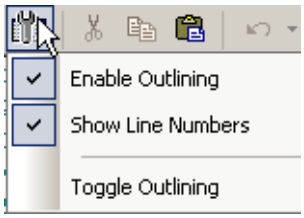
Figure 5.13: Script Editor Toolbar

The buttons have the following functions:

	Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.		Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Show Line Numbers. See **View Options Menu** below.		Go to next bookmark.
	Cut.		Go to previous bookmark.
	Copy.		Clear all bookmarks.
	Paste.		Find.
	Undo.		Find and Replace.
	Redo.		Go to Trace View
	Print.		Go to Definition of Selected Keyword.
			Open File under Cursor. Opens the file pointed to with the mouse in the script. This command works with **Include** statements.

5.9.2 View Options Menu

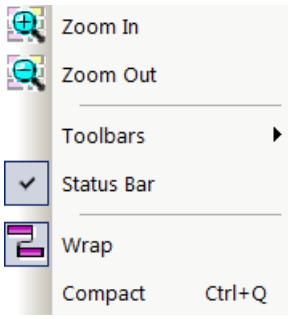
The View Options button displays a menu with the following options:



- **Enable Outlining**: Adds an expandable/collapsible tree structure to the left side of the Script Editor showing the hierarchical relationships of the script lines.
- **Show Line Numbers**: Adds line numbers to the left side of the Script Editor window.
- **Toggle Outlining**: Switches between collapsed and expanded states.

5.9.3 Pop-up Menu

Right-click anywhere in the script window to open a pop-up menu with the following options.



- **Zoom In**: Increases the size of the displayed elements
- **Zoom Out**: Decreases the size of the displayed elements
- **Toolbars**: Allows you select the toolbars to display on the top screen.
- **Status Bar:** Toggles between hiding and displaying the status bar showing the port status at the bottom of the screen.
- **Wrap**: Wraps displayed packets within the window.
- **Compact**: Displays each row on one line only, with no wrapping

5.9.4 File Tabs

At the bottom of the window is a tab that shows the name of the **.ssg** file. If your **.ssg** file has an Include statement in it, the supporting Include files automatically open when the **.ssg** file is first opened. Tabs for the opened Include files appear at the bottom of this window.

Figure 5.14: File Tab

5.9.5 Error Log

Whenever you create a scripting error, a log opens at the bottom of the application window. When the error is corrected, the window automatically closes.

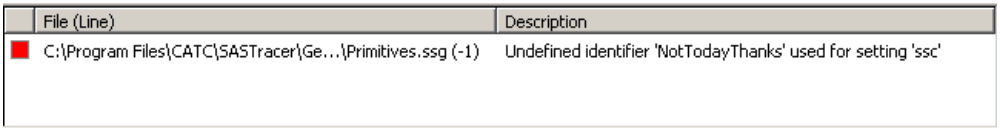


Figure 5.15: Log

5.9.6 Tooltips

The Script Editor window includes extensive tooltips for each keyword. To see a tooltip, hold the mouse pointer over a keyword.

5.10 Multi-Port Trainer Script Assignments to Links

If more than one port of Trainer is licensed, after you open a generator file (**.ssg**) or create a new generator file (“Creating a Traffic Generation File” on page 393), you can assign scripts to one or more ports.

Click the Port Configuration button to open the Set Port Configuration dialog (see “Ports Configuration” on page 106). Select a port configuration. For example, Trainer may be on Port1 and Port 2 or Port3 and Port4.

After you select port configuration, the Assign Active Script/Remove Assigned Script for Link 1, 2, 3, or 4 buttons have colors. For example, for Trainer on Ports 1 and 2, the buttons are .

After you open or create a script in the Trainer window, click the L1 or L2 button to assign the script to Port 1 or Port 2. A display appears to the left of the script in the Trainer window.

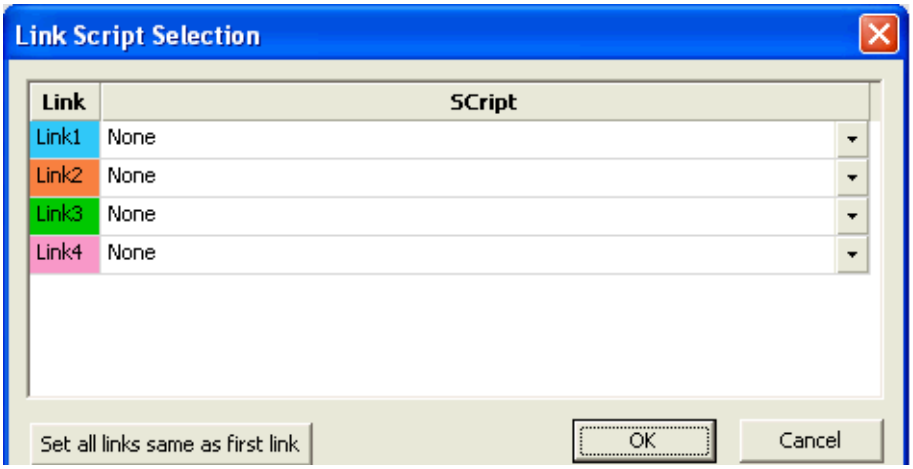
That link now has link-specific Start, Stop, Resume, Connect, and Disconnect buttons. (See the previous page for the button descriptions.)
Use the link-specific buttons to control each link separately.

You can click the L1 or L2 button again to remove the script from the link.

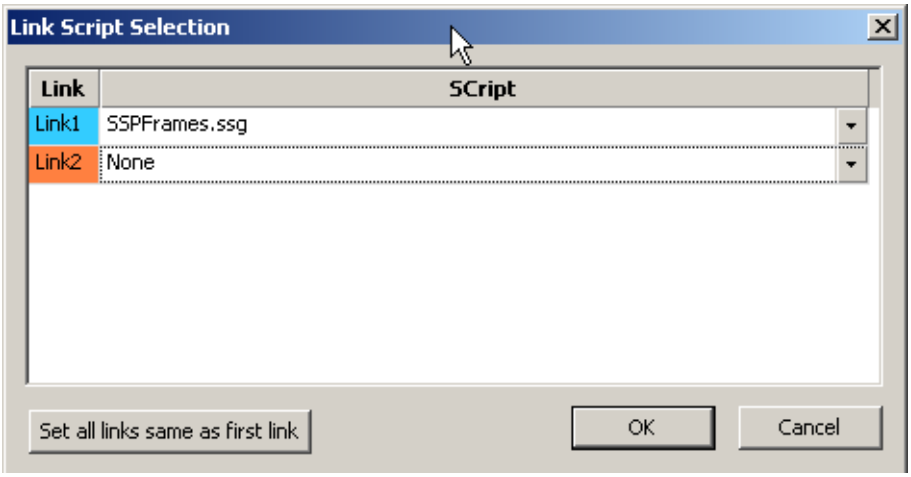
After you select port configuration, the Trainer toolbar changes to display the Generation buttons Start All Generation, Stop All Generation, Resume All Generation, Connect All Link, and Disconnect All Link.

Use these buttons to control all links.

You can click to open the Link Script Selection script assignment dialog.



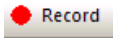
For any available Link, you can select any open script from the Script drop-down list.



After you select an open script, you can assign or remove a link for that script by clicking **Assign Active Script/Remove Assigned Script for Link.**

5.11 Generating Traffic

After the **.ssg** file has been opened onscreen, recording and traffic generation can begin at any time.

1. (optional) Click 

to begin the recording.
2. If the script does not have a connect block built into it, connect the exerciser to the DUT by clicking the **Connect Link** button . Clicking this button causes the generator to invoke the various settings in your script (for example, the global settings) and then establish a connection.
3. Click the **Start Generation** button on the Toolbar.

While generating traffic, a bar appears on the right of the trace view, indicating that traffic generation is taking place. (The green light on the Traffic signal button also blinks during traffic generation).

5.11.1 Stop Traffic Generation

Normally, traffic generation stops automatically when the application reaches the end of the Generator file.

To manually stop traffic generation, click the **Stop Generation** button .

5.11.2 Resume Traffic Generation

If traffic generation is stopped prior to the end of the script, it can be resumed.

To resume traffic generation, click the **Resume Generation** button .

5.12 Sierra Trainer Generation Language

The Sierra Trainer File Generation Language is an API that allows you to separate traffic into text commands. These commands are used construct primitives and frames that are sent to the host or the device.

5.12.1 File Structure

Traffic Generation files (***.ssg**) should have the following structure:

Declarations

- Global generation settings
- Constants
- Data patterns
- Chain of symbols (primitives, raw data)
- Packet templates

Note: Some declared objects could be used in further declarations as long as they are previously declared. No forward declarations are allowed at this time.

Generation Blocks

- List of generation instructions

Note: It is possible to create many generation blocks, but currently only a block with the name 'Generation' executes. (Calls of some blocks from another blocks are not currently allowed.)

5.12.2 Language

Comments

#' is the Comment symbol. The line remainder after this symbol is ignored.

/*' '*/' is a Comment Block. All the text between '/' '*' and '*' '/' is ignored.

```
/*
    This is an example of a block of comments.
*/
```

Includes

The directive **%include "FileName.inc"** includes the file **FileName.inc**. This lets you add common definitions and templates into new scripts.

The language parser makes sure the same file is not included more than once.

Example:

```
%include "SomeInc.inc"
# This directive actually includes file 'SomeInc_1.inc'.
```

%inline is the same as **%include**, but without the Language parser check.

5.12.3 Settings

The **Set "Constant Name" = Value** statement sets different constants/modes using the following value types:

- Predefined constants (TRUE, FALSE, ON, OFF, INFINITE)
- Numbers

Examples:

```
Set AutoAlignSATA=ON
Set WaitTimeOut=239
```

5.12.4 Constants

Only unsigned integers can be defined as constants. Some constants are predefined in Sierra Trainer.

Examples:

```
Const SOME_HEX_DATA = 0xAABBFFEE #defines hexadecimal constant
Const SOME_DEC_DATA = 12     # defines decimal constant
Const "SOME DEC DATA" = 64     # defines decimal constant
Const "Some Hex Data" = 0xCDCDBEBE
```

5.12.5 Predefined Constants

- TRUE
- FALSE
- ON

- OFF
- INFINITE

5.12.6 Data Patterns

Data patterns are streams of hexadecimal values. Using '['']' lets the user include constants or predefined data pattern in another pattern.

Examples:

```
DataPattern PATTERN_1 = AAAABBBB [SOME_HEX_DATA] EEEEFFFF   1210ABB1
AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 ["SOME DEC
DATA"] 1210AB
DataPattern PATTERN_2 = 00000000 11111111 22222222 33333333 AAAABBBB
55556666 FEFEFEFE CDCDCDCD 9999BBBB 12343434 6767676B 56BBFF
DataPattern PATTERN_3 = [PATTERN_1] FFFFFFFF EEEEEEEE [SOME_HEX_DATA]
DataPattern SOME_PATTERN = BBBBBBBB DDDDDDDD
```

5.12.7 Primitives

Primitives can be defined using the following:

- Byte values ('k' indicates control symbol). The 10b codes are calculated based on the current running disparity
- Primitives are completely interchangeable with SymChains.

Declaring Raw Data Definitions

Primitive primitive_name = byte_data … byte_data # (byte_data is Decimal, Hex, 10b, K type or D type format)

SynChain raw_data_name = byte_data … byte_data # (byte_data is Decimal, Hex, 10b, K type or D type format)

RawData { param_data … param_data } #(param_data is byte_data, primitive or variables)

Example:

```
Primitive "CHAIN (ONE)" = kBC 1E 1E 1E kBC 1A 0F
SymChain ChainTwo = k28.5 D12.3 D10.2 D11.6
SymChain ChainThree = k28.3 3EA 25 k18 IFA
Primitive SOF = kBC 18 E4 67
Primitive EOF = kBC 18 F0 9B
SymChain raw_data_1 = K28.1 D23.3 D11.4 D14.6
SymChain raw_data_2 = 345 160 023 K15.3 K28.1 D23.3 D11.4 D14.6 # some
RD errors will occur
raw_data_1 ( 1000 ) # send defined above pattern raw_data_1 1000 times
raw_data_2 (  10 )  # send defined above pattern raw_data_2   10 times
raw_data_2 ( 195 )  # send defined above pattern raw_data_2  195 times

RawData { 217 2E1 351 362 }# send RawData pattern - some RD errors
will occur
RawData { K28.1 D23.3 D11.4 D14.6 }    # send RawData pattern
```

Sending OpenAddressFrame Using Standard Frame Templates	Sending the Same OpenAddressFrame Using Raw Data Mechanism
SendOpenAddressFrameSTP {	Set ScramblingMode = SCRAMBLING_MODE_SAS
SourceAddress = { 500805EF FFFF0041 }	RawData {
DestinationAddress = { 500062B0 00000030 }	K28.5 D24.0 D30.0 D01.4
ArbitrationWaitTime = 0x1	21 08 00 01
AccessZoneManagement= 0x0	50 00 62 B0
SourceZoneGroup = 0x0	00 00 00 30
ConnectionRate = 0x8	50 08 05 EF
Features = 0x0	FF FF 00 41
InitiatorConnectionTag = 0x1	00 00 00 01
InitiatorPort = 0x0	00 00 00 00
MoreCompatibleFeatures = 0x0	05 0F 19 E0
PathwayBlockedCount = 0x0	K28.5 D24.0 D07.3 D31.4 }
# CRC = 0x050F19E0 # good crc }	* CRC is inserted manually

```
# RawData with variables embedded
RawData {
K28.5 D24.0 D30.0 D01.4
@variableName1
50 00 62 B0
00 00 00 30
50 08 05 EF
$C
00 00 00 01
00 00 00 00
SendCRC
K28.5 D24.0 D07.3 D31.4 }
}
```

When there are variable values in RawData, you must include SendCRC command instead of last dword. Otherwise, wrong CRC value will be sent. The constraints are:

- Variables are not allowed on First and LAST DWORD (instead of start/end frames).
- SendCRC is only supported on last DWORD before end of frame.

❑ Raw 10 bits codes. This definition might cause running disparity errors.

Example:

```
Primitive "CHAIN (TWO)" = 305 2D4 1E4 362
```

- Mixed bytes and 10b codes. This definition might cause running disparity errors.

Example:

```
Primitive "CHAIN (TWO)" = 305 2D4 1E4 362 ["CHAIN (ONE)"]
```

5.12.8 Packets/ Frames

Using the “Frame” or “Packet” keyword, you can define a frame of traffic to use in the generation stream. Declarations of prolog and epilog may be mixed with field declarations.

```
Frame "name" : "parent name"
{
Field Definition 0: "Field Name : Field Length = Default Value"
…
Field Definition n: "Field Name : Field Length = Default Value"
Primitive Definition 0: "Primitive name, offset, count"
…
Primitive Definition m: "Primitive name, offset, count"
Prolog = "primitive name"
Epilog = "primitive name"
}
```

Field Definition

- Field length is in bits. '*' means that the length is variable and is set based on the assigned value.
- Field starting offset is calculated from frame start based on the length of the previous fields.

Examples:

```
Field32     : 32 = 0xAABBFFEE
FrameType   : 8  = 12
HashedDest  : 24 = HEX_DATA
Reserved1   : 8  = 0xDA
Field16     : 16 = 0xAAAA
Reserved2   : 8  = 0xAD
CRC         : 32
```

Data field Definition

- **Data = { pattern }**: Pattern is assigned to Data.
- **Data = count, value**: A pattern of “count” times “value” is assigned to Data.
- **Data = count, start value, step**: A pattern of values starting with “start value” with steps of “step” and a length of “count” is assigned to Data.

Primitive Definition.

Primitives are inserted into the frame payload. Primitive definitions are inherited by descended frame templates.

- Assigning '*' clears all previous settings (maybe from parent frame template).
- Offset specifies the DWORD offset where this primitive is inserted in the Frame.
- Count specifies how many times to repeat the primitive.

Examples:

```
Primitive : *
Primitive : SOF, 48   # where 48 = offset
Primitive : "CLOSE (NORMAL)", 36, 5   # where 5 = repeat
```

Prolog and Epilog define Primitive chains to be used at the beginning and end of the frame.

Examples:

```
Prolog = SOF # For this frame primitive 'SOF' is a Prolog.
Epilog = EOF # For this frame primitive 'EOF' is an Epilog.
```

Frames can be derived from other Frames, therefore inheriting the layout of the parent Frame. In this case, the user may:

- Change Prolog and Epilog.
- Change default field values.
- Add new fields.

Frame Examples

```
Frame  Some_Frame
{
    Field32     : 32 = 0xAABBFFEE
    FrameType   : 8  = 12
    HashedDest  : 24 = HEX_DATA
    Reserved1   : 8  = 0xDA
    Field16     : 16 = 0xAAAA
    Reserved2   : 8  = 0xAD
    Data        :  * = PATTERN_1
    CRC         : 32

    Primitive : *
    Primitive : SOF, 48
    Primitive : SOF, 96
    Primitive : "CLOSE (NORMAL)", 36, 5

    Prolog = SOF
    Epilog = EOF
}
Frame Some_Frame_1 : Some_Frame
{
    Field32 = "Some Hex Data"
    Data    = { 11111111 22222222 33333333 44444444 55555555 }
    Opcode    : 128, 8, 0x2A
    LBA       : 64
```

```
    Primitive : *
    Primitive : "CLOSE (NORMAL)", 24, 48

    Prolog = "CHAIN (ONE)"
    Epilog = "CHAIN (ONE)"
}
```

5.12.9 Generation Block

Sierra Trainer generates the stream that is defined in this block.

```
Generation
{
Chain Definition (Repeat = N, Idle = M)
Chain Definition (N, M)
Chain Definition
Frame Definition
Frame Definition (RunningDisp = ON/OFF)
Frame Definition
{
Field Definition
Data Definition
} (Repeat = N, Idle = M, RunningDisp = ON/OFF)
}
```

5.12.10 Definitions

Chain Definition:

- Without any parameters, the chain is sent once.
- With “Repeat” and “Idle” parameters, the chain is sent N times and then nothing is sent (idle) M times. “Repeat” and “Idle” are optional.

Frame Definition

- Without any parameters, send the frame based in default values.
- With “RunningDisp” ON, send the frames based on default values and insert a running disparity error.
- With parameters overriding or adding to a template frame, with or without injection of an overriding or adding to a template frame, with or without injection of running disparity error.

Field Variable Declarations

You can declare a variable (var_name) as a frame of type (frame_type):

```
$var_name = frame_type
```

Note: Frame variables can be declared/re-declared and used many times.

Changing Frame Fields

You can change some fields in a frame variable.

```
Change var_name { field_name = value }
```

Preprocessor Integer Arithmetic

You can declare DWORD variables, make arithmetic operations, and use them in field and parameters assignments.

Note: Arithmetic expressions are allowed only in numeric variable assignments.

Examples:

Legal Operations

```
x = 2
y = ( z = 12 ) + ( SOME_DEC_DATA + 36 ) / 8
z = 0x1 << 5
s = "Some Hex Data" # constant may be used in operations

x++
y--
z += ( x + y )
x = ( ( y & 0xFF ) >> 5 ) / 12

SOF ( Repeat = x, Idle = y )

X
{
Field16 = 0xEEEE   # Example of the data payload assignment which uses
both integer variables, constants, hex literals and data patterns
Data    =  { y y y y 7a7a7a7a "Some Hex Data" "Some Hex Data" 8b8b8b8b
z z z z [PATTERN_3] }
}
( Repeat = 10, Idle = y )  # uses integer variable for parameter/
setting.
```

Illegal operations

```
x = y + 2
SOF ( Repeat = (x+y)*7 )
# - illegal, use z = (x+y)*7  SOF ( Repeat = z ) instead
```

Loops

Loops can be used in two modes:

1. Using an integer number, loop a specified number of loops. This number has to be smaller than 64,000.
2. Using the word “infinite”, loops for ever.

```
Loops ( loop_count/Infinite )
{
 send instructions
 assignments
 change values
 send instructions
}
```

Example:

```
LOOP( 50 )
{
        "CHAIN (ONE)"
        "CHAIN (TWO)"
        Some_Frame
        $Y = Some_Frame { Data = 256, 0xFEFEFEFE }
        Y
        Change Y { Field32 = x }
        Y
        Y
}
```

5.13 Trainer Script Enhancements

The Trainer script language can already produce SAS/SATA Primitive Sequences and Frames.

The Trainer script enhancements described in this section allow generation of Commands and Application Layer sequences (as in the Exerciser), by processing received frames, making complex decisions, and generating the contents of frame in run-time, for both RX and TX. Variables can keep the run-time state of the bus. Low-level commands can manipulate variables and use variables to create patterns.

Trainer language can perform SATA compliance tests with fast SSD devices and provide a SSD performance test tool with limited output data patterns. Trainer has sequential/ random LBA command generation and full NCQ support.

Trainer can be programmed to act as SAS Initiator, SAS Target, SATA Host, or SATA Device.

SAS Initiator

As an Initiator, Trainer can send commands in all protocols (SSP/STP/SMP) and interact with its peer to complete the command in normal conditions and some popular error conditions. Limitations are:

- Uses only one command at a time.
- Does not save Read data or reuse bulk read data for next commands.
- Sends only limited Write data patterns.
- Has tight flow control, due to limited RX frame processing.

SAS Target

As a Target, Trainer can receive commands in all protocols (SSP/STP/SMP) and respond to them in normal conditions or some popular error conditions. Limitations are:

- Uses only one command at a time. Command queuing is not supported.
- Does not save incoming write data. Sends back data for all LBAs or generates counter/random data. Cannot be used as a real formatted partition.
- Has tight flow control, due to limited RX frame processing.

SATA Host

As a Host, Trainer can send commands and complete them in normal or some popular error conditions. SATA Host can issue NCQ commands, necessary for SATA compliance tests on SSD devices. Limitations are:

- Does not save Read data or reuse bulk read data for next commands.
- Sends only limited Write data patterns.

SATA Device

As a Device, Trainer can receive commands and respond to them in normal or some popular error conditions. Limitations are:

- Uses only one command at a time. Command queuing is not supported.
- Does not save incoming write data. Sends back data for all LBAs or generates counter/random data. Cannot be used as a real formatted partition. To use the Trainer as a SATA Device in real configurations, only tools like IO-METER (that can work with un-partitioned and un-formatted drives) can be used.

5.13.1 Variable Definition

Variable definition is like definitions in programming languages. You can define up to 512 DWORD (32-bit) variables. There is no constraint on variable names, except you cannot use keywords. Variable scopes are general and you should define them in the script header before the generation block.

The syntax of variable definition is:

```
VAR32 @VariableName1, @VariableName2, ...
VAR64 @VariableName
```

VAR64 holds field values greater than 32 bits, such as SASAddress.

Note: Variable names should start with @.

5.13.2 Assigning Variable Values

You can set variable values in different ways:

- **Constant value:** `@varName1 = 1234`
- **Other variable value**: `@varName1 = @varName2`
- **Result of expression on other variables**:
  `@varName1 = @varName1 + @varName2`
- **Fields of last received frame**: `@varName1 = (SSPFrame)LRF::Frame-Type,`
  where LRF is Last Received Frame

Note: Specifying packet type (SSPFrame) before LRF causes last received frame to be this packet type, and field start-bit position is calculated according to the packet-type definition.

- **Part of last received frame**:
  `@varName1 = LRF[stratBitOffset:endBitOffset],`

where offsets are bit based

Example:

```
SendSSPFrameCommand_Initiator
    {Data = LRF[startBitOffset:endBitOffset] )
Tag = 0x101}
```

The constraints are 1) Length bigger than 64 bit is not supported and 2) Offsets (StartBitOffset and EndBitOffset) should be in same DWORD, except for length bigger than 32.

- **Random values**: `@varName1 = Random`

5.13.3 Expression on Variables

Mathematical expressions, such as sum, subtract, and shift:

```
@varName1 + @varName2
@varName1 - @ varName2
@varName1 & @varName2
@varName1 | @varName2
@varName1  <<  2
```

Logical expressions, such as compare, equal, not, and, and or:

```
@varName1  >  @varName2
@varName1 < @ varName2
@varName1 ==  @varName2
@varName1 != @ varName2
 (logical expression1) &&  (logical expression2)
(logical expression1) || (logical expression2)
```

Complex expressions (combination of different operators) with prioritizing supported:

```
(@varName1 + @varName2) > @varName3
```

5.13.4 If/While in Logical Expressions

Like programming languages, scripts allow conditional statements.
The **if/while** syntaxes are:

```
If (expression)then
{
        ….
}
else
{
       ….
}

While(@VarName)
{
     …….
}
```

Example for if, then else:

```
@HT_RxFISType = LRF[0:7]
#LRF_SATA_FIS_TYPE_START_BIT:LRF_SATA_FIS_TYPE_END_BIT
if  (@HT_RxFISType == SATA_FIS_TYPE_DMA_ACTIVATE)   then  {…}
 else { if (@HT_RxFISType == SATA_FIS_TYPE_DATA) then  {…}
            else { if (@HT_RxFISType == SATA_FIS_TYPE_RD2H)  then  {…}
} }
```

Example for while:

```
while (@NCQ_Temp0)   {
      @NCQ_Temp1= @NCQ_Temp1 >> 1
      If (@NCQ_Temp1 != 0) then { … }
      @NCQ_Temp0 = @NCQ_Temp1 & 0x00000001     }
```

Note: In this release, **while** condition is limited to simple variable values only. Combining operators is not allowed in **while** expressions. You should move such expressions inside **while** block.

Note: Nested **while** and **if** are supported.

Wait/When/Do in Logical Expressions

The **wait/when/do** syntaxes are:

```
wait (time)
{when
{exp}do
{
      ….
}
elsewhen
{
{exp}do
{
      ….
}
on_timeout
{
      ….
}}
```

Example:

```
wait  { #no timeout use global WaitTimeout value default 1000 useconds
(1 ms)
    when  {WF_OPEN_ACCEPT}   do   { … }
    elsewhen  {WF_OPEN_REJECT}   do   { … }
    on_timeout  { … }     }
```

Example:

```
wait_for (100000)  { WF_OPEN_ACCEPT  WF_TIMEOUT}  { … } # (100 ms)
```

Note: Nested wait should not exceed 2 deep. Use a procedure call to extend wait logic sequence. Wait + Wait_For ok.

5.13.5 Using Variable Values in Creating Patterns on Bus

In creating patterns to send on bus, trainer script allows using variables. In these cases, because the created pattern is dynamic, it is not possible to do scrambling and calculating in software code. These tasks are done in the hardware engine. To activate, set “Auto scramble mode” in “on” state.

The following examples show uses of variables in creating patterns.

Use variable for field value:

```
SendOpenAddressFrameSSP
{
InitiatorPort = 0x1
    InitiatorConnectionTag = @variableName1
…....
}
```

The constraints are:

- Field Length bigger than 64 bit is not supported.
- Field StartBitOffset and EndBitOffset should be in same DWORD, except for length bigger than 32.

Use LRF directly for field value:

```
SendSSPFrameCommand_Initiator
{
    Data = LRF[startBitOffset:endBitOffset]
    Tag  = 0x101
}
```

The constraints are:

- Length bigger than 64 bit is not supported.
- Offsets (StartBitOffset and EndBitOffset) should be in same DWORD, except for length bigger than 32.

```
SendSSPFrameCommand
 {
#Data = {00112233 @variableName1 @variableName2 44556677}
 }
RawData {
 K28.5  D24.0  D30.0  D01.4
              @variableName1
              50     00     62     B0
              00     00     00     30
              50     08     05     EF
              $C
              00     00     00     01
              00     00     00     00
              SendCRC
              K28.5  D24.0  D07.3  D31.4 }
}
```

When there are variable values in RawData, you must include **SendCRC** command instead of last DWORD. Otherwise, wrong CRC value will be sent.

The constraints are:

- Variables are not allowed on First and LAST DWORD (instead of start/end frames).
- **SendCRC** is only supported on last DWORD before end of frame.

```
SendSATAFrame
{
  SATA_SOF
  SATA_DATA ( 0x11223344 )
  SATA_DATA (@variableName1)
  SATA_DATA ( 0x55667788 )
  #SATA_CRC ( 0x99AACCBB ) # good crc - can be changed to bad
  SATA_EOF
}
```

If **SATA_CRC** command is not included, trainer engine computes and inserts correct CRC in pattern.

5.13.6 Timer

Trainer script syntax allows using some timers. You can start a timer anywhere. The timer current value is loadable on variable to be used in expressions and conditions on this expression. There are four timers, named A, B, C, and D.

Starting timer (setting timer value to zero) syntax is:

```
CLEAR_TIMER_A
CLEAR_TIMER_B
CLEAR_TIMER_C
CLEAR_TIMER_D
```

Loading timer current value in variables:

```
@varName1 =TIMER_A
@varName1 =TIMER_B
@varName1 =TIMER_C
@varName1 =TIMER_D
```

Example:

```
CLEAR_TIMER_A
While(@Counter < MaxPeriodCount) {
                  … @Counter = TIMER_A … }
```

5.13.7 PATTERN Counter

Trainer script syntax allows you to use counters on a number of defined events in generation settings.

Syntax for loading counters in variables is:

```
@varName1 = COUNT_REC_RESOURCE_OUTPUT_A
@varName1 = COUNT_REC_RESOURCE_OUTPUT_B
```

```
@varName1 = COUNT_REC_RESOURCE_OUTPUT_C
@varName1 = COUNT_REC_RESOURCE_OUTPUT_D
@varName1 = COUNT_REC_RESOURCE_OUTPUT_E
@varName1 = COUNT_REC_RESOURCE_OUTPUT_F
```

Syntax for clearing (resetting) counters is:

```
CLEAR_REC_RESOURCE_OUTPUT_A
CLEAR_REC_RESOURCE_OUTPUT_B
CLEAR_REC_RESOURCE_OUTPUT_C
CLEAR_REC_RESOURCE_OUTPUT_D
CLEAR_REC_RESOURCE_OUTPUT_E
CLEAR_REC_RESOURCE_OUTPUT_F
```

Example:

```
CLEAR_REC_RESOURCE_OUTPUT_A
While(@Counter < MaxPrimitiveCount) {
      … @Counter = COUNT_REC_RESOURCE_OUTPUT_A … }
```

5.13.8 Procedure Definition

Procedures allow creating simple syntaxes for complex reusable parts in scripts. You can write such code once as a procedure and use everywhere required.

Procedure definition syntax is:

```
procedure procedureName
{
...
}
```

Calling procedure syntax is:

```
Call procedureName
```

5.14 Sierra Trainer Generation Commands

5.14.1 General Commands

IDLE (n)	Generator will insert n idle DWORDs into the generation stream.
CLEAR_CREDIT_AVAIL	This commands clears the credit established with the command WF_CREDIT_AVAIL. (See WF_CREDIT_AVAIL in following section on Wait Commands for explanation).
RD_ERROR	Generator will insert one idle DWORD into the generation stream, which will intentionally break RD sequence creating RD error.

CONNECT	Generator will go through connection sequence using current GenFile settings (gen mode, speed, and so on). Generation will not resume until connection is established.
DISCONNECT	Generator will break existing connection to DUT.
PAUSE	Generator will come to a break and the user will be able to resume generation by pressing Resume button on Generation toolbar. Generator shall transmit idle DWORDs while in the Pause.
OUTPUT_ON	Takes the Trainer out of Electric Idle state. If it is already out of Electric Idle, this is a NOP.
OOB Commands	
COMINIT	Generator will send COMINIT OOB signals using current COMINIT settings.
COMRESET	Generator will send COMRESET OOB signals using current COMRESET settings.
COMWAKE	Generator will send COMWAKE OOB signals using current COMWAKE settings.
COMSAS	Generator will send COMSAS OOB signals using current COMSAS settings.
SATA_ALIGN	Generator will go through SATA_ALIGN stage of SATA SpeedNeg process using current SATA_ALIGN settings.
SATA_D10_2	Generator will go through SATA_D10_2 stage of SATA SpeedNeg process using current SATA_D10_2 settings.
SPEED_NEG_RCDT	Generator will go through SPEED_NEG_RCDT stage of SAS SpeedNeg process using current SPEED_NEG_RCDT settings.
SPEED_NEG_ALIGN0	Generator will go through SPEED_NEG_ALIGN0 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN0 settings.
SPEED_NEG_ALIGN1	Generator will go through SPEED_NEG_ALIGN1 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN1 settings.

Set Speed = LINK_SPEED_1_5G	Generator will change speed to 1.5G (if MultiSpeed is enabled). This settings is not applied when Advanced Connect is set.
Set Speed = LINK_SPEED_3G	Generator will change speed to 3G (if MultiSpeed is enabled). This settings is not applied when Advanced Connect is set.
Set Speed = LINK_SPEED_6G	Generator will change speed to 6G (if MultiSpeed is enabled). This settings is not applied when Advanced Connect is set.
Send_Phy_Capability	Generator will send PHY Capability Bits. (this command is used in SNW3).
Send_Train_TrainDone	Generator will send Train/Train Done Patterns. (This Command is used in Train Windows).
Delay (#)	Generator will wait until # ns before executing next command.
Power_Expansion_On	Switch on power expansion card.
Power_Expansion_Off	Switch off power expansion card
Exit (ExitCode)	Call this command in any branch of the Trainer program to stop execution. After exit, the Port Status dialog displays the exit code. **Note**: The Trainer GUI has LED indicators: Green is for pass. Red is for fail. No color is for unknown or for user to review.

5.14.2 SATA Commands

Look at STP sample file for syntax.

- SEND_SATA_FRAME
- SendSATAFrame
- SATAData
- SATA_Data
- SATACRC
- SATA_CRC
- SATAXXXX
- SATA_XXXX

5.14.3 Primitive Commands

The following is a list of SAS and SATA primitives declared in **Primitives.Decl.inc** as Symbol Chains. If you want to use these primitives in your script, you must also include **Primitives.Decl.inc** in your script.

- SOF
- EOF
- SOAF
- EOAF
- ALIGN (0)
- ALIGN (1)
- ALIGN (2)
- ALIGN (3)
- NOTIFY (ENABLE SPINUP)
- NOTIFY (RESERVED 0)
- NOTIFY (RESERVED 1)
- NOTIFY (RESERVED 2)
- ACK
- NAK (CRC ERROR)
- NAK (RESERVED 0)
- NAK (RESERVED 1
- NAK (RESERVED 2)
- CREDIT_BLOCKED
- RRDY (NORMAL)
- RRDY (RESERVED 0)
- RRDY (RESERVED 1)
- SATA_SOF
- SATA_EOF
- SATA_CONT
- SATA_DMAT
- SATA_HOLD
- SATA_HOLDA
- SATA_PMACK
- SATA_PMNAK
- SATA_PMREQ_P
- SATA_PMREQ_S
- SATA_R_ERR
- SATA_R_IP
- SATA_R_OK
- SATA_R_RDY
- SATA_SYNC
- SATA_WTRM
- SATA_X_RDY
- SATA_ERROR
- AIP (NORMAL)
- AIP (RESERVED 0)
- AIP (RESERVED 1)
- AIP (RESERVED 2)

- AIP (RESERVED 3)
- AIP (WAITING ON CONNECTION)
- AIP (WAITING ON DEVICE)
- AIP (WAITING ON PARTIAL)
- BREAK
- BROADCAST (CHANGE)
- BROADCAST (RESERVED 0)
- BROADCAST (RESERVED 1)
- BROADCAST (RESERVED 2)
- BROADCAST (RESERVED 3)
- BROADCAST (RESERVED 4)
- BROADCAST (RESERVED CHANGE 0)
- BROADCAST (RESERVED CHANGE 1)
- CLOSE (CLEAR AFFILIATION)
- CLOSE (NORMAL)
- CLOSE (RESERVED 0)
- CLOSE (RESERVED 1)
- ERROR
- HARD_RESET
- OPEN_ACCEPT
- OPEN_REJECT (BAD DESTINATION)
- OPEN_REJECT (CONNECTION RATE NOT SUPPORTED)
- OPEN_REJECT (NO DESTINATION)
- OPEN_REJECT (PATHWAY BLOCKED)
- OPEN_REJECT (PROTOCOL NOT SUPPORTED)
- OPEN_REJECT (RESERVED ABANDON 0)
- OPEN_REJECT (RESERVED ABANDON 1)
- OPEN_REJECT (RESERVED ABANDON 2)
- OPEN_REJECT (RESERVED ABANDON 3)
- OPEN_REJECT (RESERVED CONTINUE 0)
- OPEN_REJECT (RESERVED CONTINUE 1)
- OPEN_REJECT (RESERVED INITIALIZE 0)
- OPEN_REJECT (RESERVED INITIALIZE 1)
- OPEN_REJECT (RESERVED STOP 0)
- OPEN_REJECT (RESERVED STOP 1)
- OPEN_REJECT (RETRY)
- OPEN_REJECT (STP RESOURCES BUSY)
- OPEN_REJECT (WRONG DESTINATION)
- DONE (ACK/NAK TIMEOUT)
- DONE (CREDIT TIMEOUT)
- DONE (NORMAL)
- DONE (RESERVED 0)
- DONE (RESERVED 1)
- DONE (RESERVED TIMEOUT 0)
- DONE (RESERVED TIMEOUT 1)
- SAS Specific Script-Defined Constants
- SAS_AF_DT_NO_DEVICE_ATTACHED
- SAS_AF_DT_END_DEVICE

- SAS_AF_DT_EDGE_EXPANDER_DEVICE
- SAS_AF_DT_FANOUT_EXPANDER_DEVICE
- SAS_AF_FT_IDENTIFY
- SAS_AF_FT_OPEN
- SAS_AF_PROTOCOL_SMP
- SAS_AF_PROTOCOL_SSP
- SAS_AF_PROTOCOL_STP
- SAS_AF_PROTOCOL_UNKNOWN
- SAS_AF_RATE_1_5_GBPS
- SAS_AF_RATE_3_GBPS
- SAS_AF_RATE_6_GBPS
- SMP_FRAME_TYPE_REQUEST
- SMP_FRAME_TYPE_RESPONSE
- SMP_REPORT_GENERAL
- SMP_REPORT_MANUFACTURER_INFO
- SMP_DISCOVER
- SMP_REPORT_PHY_ERROR_LOG
- SMP_REPORT_PHY_SATA
- SMP_REPORT_ROUTE_INFO
- SMP_CONFIGURE_ROUTE_INFO
- SMP_PHY_CONTROL
- SSP_FRAME_TYPE_DATA
- SSP_FRAME_TYPE_XFER_RDY
- SSP_FRAME_TYPE_COMMAND
- SSP_FRAME_TYPE_RESPONSE
- SSP_FRAME_TYPE_TASK
- SSP_FRAME_TYPE_VENDOR
- MUX (LOGICAL 0)
- MUX (LOGICAL 1)
- BREAK_REPLY
- TRAIN
- TRAIN_DONE
- PS_ACK
- PS_NAK
- PS_REQ_PARTIAL
- PS_REQ_SLUMBER

5.14.4 Primitive Category

- **ALIGN**: 0, 1, 2, or 3
- **NOTIFY**: ENABLE SPINUP, RESERVED 0, RESERVED 1, or RESERVED 2
- ACK
- **NAK**: CRC ERROR, RESERVED 0, RESERVED 1, or RESERVED 2
- **RRDY**: NORMAL, RESERVED 0, RESERVED 1
- **AIP**: NORMAL, RESERVED 0, RESERVED 1, RESERVED 2, RESERVED 3, WAITING ON CONNECTION, WAITING ON DEVICE, or WAITING ON PARTIAL
- BREAK
- **CLOSE**: CLEAR AFFILIATION, NORMAL, RESERVED 0, RESERVED 1

- CREDIT BLOCKED
- OPEN ACCEPT
- **OPEN REJECT**: BAD DESTINATION, CONNECTION RATE NOT SUPPORTED, NO DESTINATION, PATHWAY BLOCKED, PROTOCOL NOT SUPPORTED, RESERVED ABANDON 0, RESERVED ABANDON 1, RESERVED ABANDON 2, RESERVED ABANDON 3, RESERVED CONTINUE 0, RESERVED CONTINUE 1, RESERVED INITIALIZE 0, RESERVED INITIALIZE 1, RESERVED STOP 0, RESERVED STOP 1, RETRY, STP RESOURCES BUSY, or WRONG DESTINATION
- **BROADCAST**: CHANGE, RESERVED 0, RESERVED 1, RESERVED 2, RESERVED 3, RESERVED 4, RESERVED CHANGE 0, or RESERVED CHANGE 1
- **DONE**: ACK/NAK TIMEOUT, CREDIT TIMEOUT, NORMAL, RESERVED 0, RESERVED 1, RESERVED TIMEOUT 0, or RESERVED TIMEOUT 1
- SATA FLOW CTRL PRIMITIVE
- SATA IDLE PRIMITIVE
- **SAS PS PRIMITIVE**: PS_REQ_PARTIAL, PS_REQ_SLUMBER, PS_ACK, or PS_NAK

5.14.5 Wait Commands

Syntax:

```
WAIT_FOR { <command1> <command2> ... <group1> <group2> ... }
```

Wait Command Name	Description
WF_TIMEOUT	Timeout Credit Available When WF_TIMEOUT is requested in WAIT_FOR command, the wait session will be released after timeout has elapsed. The Timeout value can be set two different ways: 1. Through the global WaitTimeout setting that can appear anywhere in generation. Default value is 1000 microseconds. Syntax: **Set WaitTimeout = <value> (in microseconds)** 2. Through local WaitTimeout value for this specific wait session. Syntax: **WAIT_FOR (<number_of_microseconds>) {WF_TIMEOUT <other_wait_commands>}** In this case wait for other commands will be released no later then after number_of_microseconds, but global WaitTimeout value remains unchanged for future use. See **Generation\Include\ WaitCommands.inc** in the program folder for the samples of syntax.
WF_SOF	primitive
WF_EOF	primitive
WF_SOAF	primitive
WF_EOAF	primitive
WF_ACK	primitive
WF_NAK_CRC_ERROR	primitive
WF_NAK_RESERVED_0	primitive
WF_NAK_RESERVED_1	primitive
WF_NAK_RESERVED_2	primitive

Wait Command Name	Description
WF_CREDIT_AVAIL	Credit Available This function is based on a 10-bit counter whose value can range from -512 to +511 (twos-complement). This counter is cleared by sending or receiving an OPEN_ACCEPT primitive, or by execution of a CLEAR_CREDIT_AVAIL command in the script. This counter is incremented by receiving any SAS RRDY primitive and is decremented by sending SAS SOF. The wait_for command will wait for this counter to have a positive value between +1 and +511. This wait_for condition is intended to be used before sending a SAS frame within a connection. ClEAR_CREDIT_AVAIL clears this credit function.
WF_CREDIT_BLOCKED_RECEIVED	CreditBlocked Received This function is based on a flip-flop which is cleared by sending or receiving an OPEN_ACCEPT primitive. It is set by receiving a CREDIT_BLOCKED primitive. It is intended to be used in conjunction with wf_credit_avail to prevent script hangs in those cases where there is not going to be any more credit granted.
WF_CREDIT_BLOCKED	primitive
WF_RRDY_NORMAL	primitive
WF_RRDY_RESERVED_0	primitive
WF_RRDY_RESERVED_1	primitive
WF_BREAK	primitive
WF_CLOSE_CLEAR_AFFILIATION	primitive
WF_CLOSE_NORMAL	primitive
WF_CLOSE_RESERVED_0	primitive
WF_CLOSE_RESERVED_1	primitive
WF_DONE_ACK_NAK_TIMEOUT	primitive
WF_DONE_CREDIT_TIMEOUT	primitive
WF_DONE_NORMAL	primitive

Wait Command Name	Description
WF_DONE_RESERVED_0	primitive
WF_DONE_RESERVED_1	primitive
WF_DONE_RESERVED_TIMEOUT_0	primitive
WF_DONE_RESERVED_TIMEOUT_1	primitive
WF_ERROR	primitive
WF_HARD_RESET	primitive
WF_AIP_NORMAL	primitive
WF_AIP_RESERVED_0	primitive
WF_AIP_RESERVED_1	primitive
WF_AIP_RESERVED_2	primitive
WF_AIP_RESERVED_WAIT_ON_PART	primitive
WF_AIP_WAIT_ON_CONN	primitive
WF_AIP_WAIT_ON_DEVICE	primitive
WF_AIP_WAIT_ON_PARTIAL	primitive
WF_IDENTIFY_FRAME	Identify Address Frame
WF_OPEN_FRAME	Open Address Frame
WF_SMP_REQUEST	SMP Request Frame
WF_SMP_RESPONSE	SMP Response Frame
WF_REC_RESOURCES_OUTPUT_A	Advanced Wait Condition A This command causes generation to wait for Event "A" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_B	Advanced Wait Condition B This command causes generation to wait for Event "B" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_C	Advanced Wait Condition C This command causes generation to wait for Event "C" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_D	Advanced Wait Condition D This command causes generation to wait for Event "D" to occur that you defined in the Generation Options dialog described at the end of this chapter.

Wait Command Name	Description
WF_REC_RESOURCES_OUTPUT_E	Advanced Wait Condition E This command causes generation to wait for Event "E" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_F	Advanced Wait Condition F This command causes generation to wait for Event "F" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_COMRESET_COMINIT	COMRESET OOB Signals
WF_COMSAS	COMSAS OOB Signals
WF_COMWAKE	COMWAKE OOB Signals
WF_BLOCK1_MISC_RESERVED_0	reserved
WF_BLOCK1_MISC_RESERVED_1	reserved
WF_BLOCK1_MISC_RESERVED_2	reserved
WF_BLOCK1_MISC_RESERVED_3	reserved
WF_BLOCK1_MISC_RESERVED_4	reserved
WF_SATA_CONT	primitive
WF_SATA_DMAT	primitive
WF_SATA_EOF	primitive
WF_SATA_ERROR	primitive
WF_SATA_HOLD	primitive
WF_SATA_HOLDA	primitive
WF_SATA_PMACK	primitive
WF_SATA_PMNAK	primitive
WF_SATA_PMREQ_P	primitive
WF_SATA_PMREQ_S	primitive
WF_SATA_R_ERR	primitive
WF_SATA_R_IP	primitive
WF_SATA_R_OK	primitive
WF_SATA_R_RDY	primitive
WF_SATA_SOF	primitive
WF_SATA_SYNC	primitive
WF_SATA_WTRM	primitive
WF_SATA_X_RDY	primitive
WF_OPEN_ACCEPT	primitive
WF_OPEN_REJECT_BAD_DESTINATION	primitive

Wait Command Name	Description
WF_OPEN_REJECT_CONN_RATE_NOT_SUPPORTED	primitive
WF_OPEN_REJECT_NO_DESTINATION	primitive
WF_OPEN_REJECT_PATHWAY_BLOCKED	primitive
WF_OPEN_REJECT_PROTOCOL_NOT_SUPPORTED	primitive
WF_OPEN_REJECT_RETRY	primitive
WF_OPEN_REJECT_STP_RESOURCES_BUSY	primitive
WF_OPEN_REJECT_WRONG_DESTINATION	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_0	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_1	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_2	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_3	primitive
WF_OPEN_REJECT_RESERVED_CONTINUE_0	primitive
WF_OPEN_REJECT_RESERVED_CONTINUE_1	primitive
WF_OPEN_REJECT_RESERVED_INITIALIZE_0	primitive
WF_OPEN_REJECT_RESERVED_INITIALIZE_1	primitive
WF_OPEN_REJECT_RESERVED_STOP_0	primitive
WF_OPEN_REJECT_RESERVED_STOP_1	primitive
WF_ALIGN_0	primitive
WF_ALIGN_1	primitive
WF_ALIGN_2	primitive
WF_ALIGN_3	primitive
WF_NOTIFY_ENABLE_SPINUP	primitive
WF_NOTIFY_RESERVED_0	primitive
WF_NOTIFY_RESERVED_1	primitive
WF_NOTIFY_RESERVED_2	primitive
WF_BROADCAST_CHANGE	primitive
WF_BROADCAST_RESERVED_0	primitive
WF_BROADCAST_RESERVED_1	primitive
WF_BROADCAST_RESERVED_2	primitive
WF_BROADCAST_RESERVED_3	primitive
WF_BROADCAST_RESERVED_4	primitive
WF_BROADCAST_RESERVED_CHANGE_0	primitive

Wait Command Name	Description
WF_BROADCAST_RESERVED_CHANGE_1	primitive
WF_BLOCK2_MISC_RESERVED_0	reserved
WF_BLOCK2_MISC_RESERVED_1	reserved
WF_TRAIN	primitive
WF_TRAIN_DONE	primitive
WF_BREAK_REPLY	primitive
WF_MUX_LOGICAL_0	primitive
WF_MUX_LOGICAL_1	primitive
WF_PS_REQ_PARTIAL	primitive
WF_PS_REQ_SLUMBER	primitive
WF_PS_ACK	primitive
WF_PS_NAK	primitive

5.14.6 Wait Command Groups

Wait Command Group	Group Contents
WF_TIMEOUT	WF_TIMEOUT_BLOCK_ONE WF_TIMEOUT_BLOCK_TWO
WF_ALL_SOF	WF_SOF
	WF_SOAF
WF_ALL_EOF	WF_EOF
	WF_SOAF
WF_NAK	WF_NAK_CRC_ERROR
	WF_NAK_RESERVED_0
	WF_NAK_RESERVED_1
	WF_NAK_RESERVED_2
WF_RRDY	WF_RRDY_NORMAL
	WF_RRDY_RESERVED_0
	WF_RRDY_RESERVED_1
WF_CREDIT_OK	WF_CREDIT_AVAIL
	WF_CREDIT_BLOCKED_RECEIVED
WF_CLOSE	WF_CLOSE_CLEAR_AFFILIATION
	WF_CLOSE_NORMAL
	WF_CLOSE_RESERVED_0
	WF_CLOSE_RESERVED_1

Wait Command Group	Group Contents
WF_DONE	WF_DONE_ACK_NAK_TIMEOUT
	WF_DONE_CREDIT_TIMEOUT
	WF_DONE_NORMAL
	WF_DONE_RESERVED_0
	WF_DONE_RESERVED_1
	WF_DONE_RESERVED_TIMEOUT_0
	WF_DONE_RESERVED_TIMEOUT_1
WF_AIP	WF_AIP_NORMAL
	WF_AIP_RESERVED_0
	WF_AIP_RESERVED_1
	WF_AIP_RESERVED_2
	WF_AIP_RESERVED_WAIT_ON_PART
	WF_AIP_WAIT_ON_CONN
	WF_AIP_WAIT_ON_DEVICE
	WF_AIP_WAIT_ON_PARTIAL
WF_REC_RESOURCES	WF_REC_RESOURCES_OUTPUT_A
	WF_REC_RESOURCES_OUTPUT_B
	WF_REC_RESOURCES_OUTPUT_C
	WF_REC_RESOURCES_OUTPUT_D
	WF_REC_RESOURCES_OUTPUT_E
	WF_REC_RESOURCES_OUTPUT_F
WF_RCV_STATUS	WF_SATA_R_ERR
	WF_SATA_R_OK
WF_PM_REQ	WF_SATA_PMREQ_P
	WF_SATA_PMREQ_S
WF_PM_STATUS	WF_SATA_PMACK
	WF_SATA_PMNAK

Wait Command Group	Group Contents
WF_OPEN_REJECT	WF_OPEN_REJECT_BAD_DESTINATION
	WF_OPEN_REJECT_CONN_RATE_NOT_SUPPORTED
	WF_OPEN_REJECT_NO_DESTINATION
	WF_OPEN_REJECT_PATHWAY_BLOCKED
	WF_OPEN_REJECT_PROTOCOL_NOT_SUPPORTED
	WF_OPEN_REJECT_RETRY
	WF_OPEN_REJECT_STP_RESOURCES_BUSY
	WF_OPEN_REJECT_WRONG_DESTINATION
	WF_OPEN_REJECT_RESERVED_ABANDON_0
	WF_OPEN_REJECT_RESERVED_ABANDON_1
WF_OPEN_REJECT (continued...)	WF_OPEN_REJECT_RESERVED_ABANDON_2
	WF_OPEN_REJECT_RESERVED_ABANDON_3
	WF_OPEN_REJECT_RESERVED_CONTINUE_0
	WF_OPEN_REJECT_RESERVED_CONTINUE_1
	WF_OPEN_REJECT_RESERVED_INITIALIZE_0
	WF_OPEN_REJECT_RESERVED_INITIALIZE_1
	WF_OPEN_REJECT_RESERVED_STOP_0
	WF_OPEN_REJECT_RESERVED_STOP_1
WF_OPEN_RESPONSE	WF_OPEN_ACCEPT
	WF_OPEN_REJECT
WF_ALIGN	WF_ALIGN_0
	WF_ALIGN_1
	WF_ALIGN_2
	WF_ALIGN_3
WF_NOTIFY	WF_NOTIFY_ENABLE_SPINUP
	WF_NOTIFY_RESERVED_0
	WF_NOTIFY_RESERVED_1
	WF_NOTIFY_RESERVED_2

Wait Command Group	Group Contents
WF_BROADCAST	WF_BROADCAST_CHANGE
	WF_BROADCAST_RESERVED_0
	WF_BROADCAST_RESERVED_1
	WF_BROADCAST_RESERVED_2
	WF_BROADCAST_RESERVED_3
	WF_BROADCAST_RESERVED_4
	WF_BROADCAST_RESERVED_CHANGE_0
	WF_BROADCAST_RESERVED_CHANGE_1
WF_SAS_PS_REQ	WF_PS_REQ_PARTIAL
	WF_PS_REQ_SLUMBER
WF_SAS_PS_STATUS	WF_PS_ACK
	WF_PS_ACK

5.14.7 Predefined Constants

Predefined Constant	Internal Value
GEN_MODE_ERROR	0
GEN_MODE_SATA_HOST	1
GEN_MODE_SATA_DEVICE	2
GEN_MODE_SAS_INITIATOR	3
GEN_MODE_SAS_TARGET	4
GEN_LINK_SPEED_1_5G	00
GEN_LINK_SPEED_3G	01
GEN_LINK_SPEED_6G	10
SCRAMBLING_MODE_NONE	0
SCRAMBLING_MODE_SAS	1
SCRAMBLING_MODE_SATA	2

5.14.8 Generation Settings

Setting	Default Value	Description
Global Settings		
GenerationMode	>>>>>	Generation Mode - must be defined or no generation will take place. Possible Values: GEN_MODE_SATA_HOST GEN_MODE_SATA_DEVICE GEN_MODE_SAS_INITIATOR GEN_MODE_SAS_TARGET Default Value: GEN_MODE_ERROR - undefined mode
SSCEnable	0	Spread Spectrum Clocking (SSC) In SATA software, turns SSC on or off. Can only be set outside Generation block. In SAS software, when you turn on SSC, Trainer PHY can turn on SSC on the PHY. In the SAS protocol, during speed negotiation, when both sides of a link agree to turn on their SSC, SSC will turn on, with the SSC Type and SSC Amplitude parameters.
SSCType		Specifies SSC type as midspread.
SSCAmplitude		Specifies SSC Amplitude. Possible values are: SSC_AMP_500 SSC_AMP_1000 SSC_AMP_1500 SSC_AMP_2000 SSC_AMP_2500 SSC_AMP_3000
MultiSpeedMode	0	When set, the change of speed within Generation block is allowed with following syntax: set Speed = LINK_SPEED_1_5G / LINK_SPEED_3G / LINK_SPEED_6G
Output Disable	0	This very poorly named register bit forces the Trainer to output data. It is a little like the output_on script command except that its effect cannot be undone for the duration of the script. If this is turned on, none of the out-of-band commands will work, as the output enable is forced on.
SupportSNW1	1	When set, in “Connect command” SNW1 will be tried in Speed Negotiation phase Can only be set outside Generation block.
SupportSNW2	1	When set, in “Connect command” SNW2 will be tried in Speed Negotiation phase. Can only be set outside Generation block.

Setting	Default Value	Description
PauseTrnScrmblr.	0	When set, the generator pauses the Idle scrambler of Train/TrainDone pattern.
ReconnectOnRun	0	When “AdvanceConnect” and “ReconnectOnRun” are set, the “Connect” command forces the Trainer to disconnect the physical link before executing the “Connect” command. When “AdvanceConnect” is not set, this setting does not affect the Trainer.
AdvanceConnect	0	When set, the Trainer uses the “PHY Capability” and “SupportSNW” settings, instead of the “Set Speed” settings, for executing the “Connect” command.
OutputOffAfterDC	On Off	If set to On, Trainer puts DC Idle on line when it detects sync lost on the link.
AutoMode Settings		
AutoOOBMode	On	When set, the generator will go through the stages of bringing up the link automatically, including waiting for and responding to the device or host it is connected to.
AutoHoldMode	0	When set, the generator will respond automatically to Hold requests. Not supported for version 1.1 (reserved).
AutoDMAT	0	When set, the generator will respond automatically to DMAT requests. Not supported for version 1.1 (reserved).
AutoHandshake	0	When set, the generator will respond automatically to TBD commands. Not supported for version 1.1 (reserved).
AutoSpeedNeg	On	When set, the generator will automatically go throughthe speed negotiation process, for the speed set in the PINTERFACEC_SERDES register for the Trainer.
AutoAlignSATA	0	When set, the generator will automatically inserting the stream 2 Align(0) primitives every 254 DWORDs, as specified in the SATA spec.
AutoAlignSAS	On	When set, the generator will automatically inserting the stream Align primitives every 2048 DWORDs, as specified in the SAS spec.Two Align modes can be turned on simultaneously, to support STP

Setting	Default Value	Description
COMINIT Settings		
COMINIT_NegLen	800	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMINIT_IdleLen	480	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMINIT_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMINIT_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMWAKE Settings		
COMWAKE_NegLen	280	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMWAKE_IdleLen	160	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMWAKE_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMWAKE_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMSAS Settings		
COMSAS_NegLen	2400	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMSAS_IdleLen	1440	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMSAS_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMSAS_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.

Setting	Default Value	Description
SATA Link Init Settings		
OOB_SATA_D102_Time	100000	D10.2 time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit D10.2 symbols.
OOB_SATA_Align_Time	100000	ALIGN(0) time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.
SAS Speed Negotiation Settings		
OOB_SAS_Align1_Time	81920	ALIGN(1) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(1) primitives.
OOB_SAS_Align0_Time	81920	ALIGN(0) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.
OOB_SAS_Interspeed_Time	750000	Interspeed time for SAS speed negotiation in OOBIs.During the specified period, the generator will keep the line at electric idle.
OOB_SpeedNeg_MTT.	29998080 OOBI	The maximum time in OOBI during which training phase of speed negotiation should be completed in Train-SNW.
OOB_SpeedNeg_SNTT.	2200 OOBI	The time in OOBI during which generator transmits phy capability bits in SNW-3. In Automatic connection This value is also used for the time during which generator sends Align0 and Align1 in SNW1 and SNW2.
OOB_SpeedNeg_BCT.	2200 OOBI	The time in OOBI during which generator transmits COMWAKE or D.C. idle during SNW-3.

Setting	Default Value	Description
Phy Capabilities Settings		
OOB_SpeedNeg_Phy_start		The START bit shall be set to one. The phy's receiver shall use this bit to establish the timing for the subsequent bits.
OOB_SpeedNeg_ Phy_txSSCtype		A TX SSC TYPE bit set to one indicates that the phy's transmitter uses center-spreading SSC when SSC is enabled. A TX SSC TYPE bit set to zero indicates that the phy's transmitter uses down-spreading SSC when SSC is enabled or that the phy does not support SSC.
OOB_SpeedNeg_Phy_RLLR		The REQUESTED LOGICAL LINK RATE field indicates if the phy supports multiplexing and, if so, the logical link rate that the phy is requesting.
OOB_SpeedNeg_ Phy_g1WithoutSSC		A G1 WITHOUT SSC bit set to one indicates that the phy supports G1 (i.e., 1.5 Gbps) without SSC. A G1 WITHOUT SSC bit set to zero indicates that the phy does not support G1 without SSC.
OOB_SpeedNeg_ Phy_g1WithSSC		A G1 WITH SSC bit set to one indicates that the phy supports G1 (i.e., 1.5 Gbps) with SSC. A G1 WITH SSC bit set to zero indicates that the phy does not support G1 with SSC.
OOB_SpeedNeg_ Phy_g2WithoutSSC		A G2 WITHOUT SSC bit set to one indicates that the phy supports G2 (i.e., 3 Gbps) without SSC. A G2 WITHOUT SSC bit set to zero indicates that the phy does not support G2 without SSC.
OOB_SpeedNeg_ Phy_g2WithSSC		A G2 WITH SSC bit set to one indicates that the phy supports G2 (i.e., 3 Gbps) with SSC. A G2 WITH SSC bit set to zero indicates that the phy does not support G2 with SSC.
OOB_SpeedNeg_ Phy_g3WithoutSSC		A G3 WITHOUT SSC bit set to one indicates that the phy supports G3 (i.e., 6 Gbps) without SSC. A G3 WITHOUT SSC bit set to zero indicates that the phy does not support G3 without SSC.
OOB_SpeedNeg_ Phy_g3WithSSC		A G3 WITH SSC bit set to one indicates that the phy supports G3 (i.e., 6 Gbps) with SSC. A G3 WITH SSC bit set to zero indicates that the phy does not support G3 with SSC.
OOB_SpeedNeg_Phy_Parity		The PARITY bit provides for error detection of all the SNW-3 phy capabilities bits. The PARITY bit shall be set to one or zero such that the total number of SNW-3 phy capabilities bits that are set to one is even, including the START bit and the PARITY bit.

Setting	Default Value	Description
SATA Speed Negotiation Settings		
OOB_SpeedNeg_RCDT	750000	Maximum time in OOBIs during the speed negotiation window for a transmitter to reply with ALIGN(1).
OOB_SpeedNeg_SNTT	163840	Time in OOBIs during which ALIGN(0) or ALIGN(1) is transmitted at each physical link rate during the speed negotiation sequence.
OOB_SpeedNeg_SNLT	153600	Time in OOBIs during which the transmitter shall transmit idle between rates during speed negotiation.
Speed Settings		
Speed	>>>>>	Link Speed Possible Values: LINK_SPEED_1_5G LINK_SPEED_3G LINK_SPEED_6G Default Value: LINK_SPEED_1_5G
RateMatching	0	When set, the generator will automatically inserting the stream Align(0) primitive after every DWORD.
Scrambling Mode Settings		
Scrambling	>>>>>	Raw Data Scrambling Mode - Only those raw DWORDs will be scrambled that contain only data bytes (no 10-bit symbols or 'K' bytes. Scrambling is reset by changing ScramblingMode or by any valid SAS or SATA frame. When **Scrambling** is on, scrambling is done by Trainer engine. It automatically detects scrambling type (SAS or SATA) by start frame primitive. When **Scrambling** is off, data is sent without any scrambling. Possible Values: SCRAMBLING_MODE_NONE SCRAMBLING_MODE_SAS SCRAMBLING_MODE_SATA SCRAMBLING_MODE_AUTO Default Value: SCRAMBLING_MODE_AUTO
Wait Timeout Settings		
WaitTimeout	1000	Sets global WaitTimeout value in microseconds

Setting	Default Value	Description
AUTO_WAIT_SAS_AFTER Settings		
AUTO_WAIT_SAS_AFTER_CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command immediately after each CLOSE primitive.
AUTO_WAIT_SAS_AFTER_EOF_FOR_ACK	FALSE	When set, the generator will insert WAIT_FOR ACK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_EOF_FOR_ACK_OR_NAK	FALSE	When set, the generator will insert WAIT_FOR ACK or NAK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_OPEN_FOR_OPEN_ACCEPT	FALSE	When set, the generator will insert WAIT_FOR OPEN_ACCEPT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_OPEN_FOR_OPEN_REJECT	FALSE	When set, the generator will insert WAIT_FOR OPEN_REJECT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_IDENTIFY_FOR_IDENTIFY_FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command immediately after each Identify Address Frame.
AUTO_WAIT_SAS_AFTER_SMP_REQ_FOR_RESP	FALSE	When set, the generator will insert WAIT_FOR SMP Response Frame command immediately after each SMP Request Frame.
AUTO_WAIT_SAS_BEFORE Settings		
AUTO_WAIT_SAS_BEFORE_CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command right before each CLOSE primitive.
AUTO_WAIT_SAS_BEFORE_SOF_FOR_CREDIT	FALSE	When set, the generator will insert WAIT_FOR CREDIT command right before each SOF primitive.
AUTO_WAIT_SAS_BEFORE_IDENTIFY_FOR_IDENTIFY_FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command right before each Identify Address Frame.
AUTO_WAIT_SAS_BEFORE_OPEN_ACCEPT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_ACCEPT primitive.
AUTO_WAIT_SAS_BEFORE_OPEN_REJECT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_REJECT primitive.
AUTO_WAIT_SAS_BEFORE_AIP_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each primitive of AIP group.
AUTO_WAIT_SAS_BEFORE_SMP_RESP_FOR_REQ	FALSE	When set, the generator will insert WAIT_FOR SMP Request Frame command right before each SMP Response Frame.

Setting	Default Value	Description
AUTO_WAIT_SATA_AFTER Settings		
AUTO_WAIT_SATA_AFTER_X_RDY_FOR_R_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_R_RDY command immediately after each case of SATA_CONT primitive following SATA_X_RDY primitive.
AUTO_WAIT_SATA_AFTER_WTRM_FOR_STATUS	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR or SATA_R_OK command immediately after each case of SATA_CONT primitive following SATA_WTRM primitive.
AUTO_WAIT_SATA_AFTER_PMREQ_S_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_S primitive.
AUTO_WAIT_SATA_AFTER_PMREQ_P_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_P primitive.
AUTO_WAIT_SATA_AFTER_SYNC_FOR_SYNC	FALSE	When set, the generator will insert WAIT_FOR SATA_SYNC command immediately after each case of SATA_CONT primitive following SATA_SYNC primitive.
AUTO_WAIT_SATA_BEFORE Settings		
AUTO_WAIT_SATA_BEFORE_PMACK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMACK primitive.
AUTO_WAIT_SATA_BEFORE_PMNAK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMNAK primitive.
AUTO_WAIT_SATA_BEFORE_RERR_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_ROK_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_OK command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_RIP_FOR_SOF	FALSE	When set, the generator will insert WAIT_FOR SATA_R_IP command right before each SATA_SOF primitive.
AUTO_WAIT_SATA_BEFORE_R_RDY_FOR_X_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_X_RDY command right before each SATA_R_RDY primitive.

5.15 Generation Options

Use the Generation Rules to set triggers and filters.

To display the Generation Options dialog, select **Generate > Generation Options** or click the **Setup Generation Options** button.

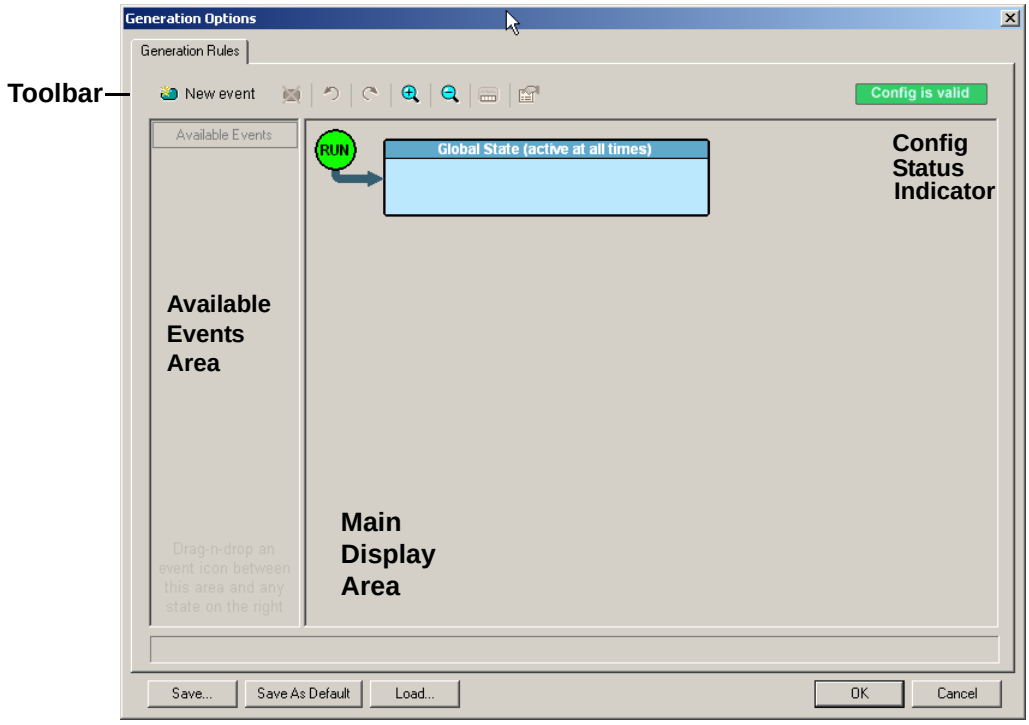


Figure 5.16: Generation Options Window

The page has the following areas:

- **Toolbar:** Contains buttons that control the Generation Rules page.
- **Available Events Area:** Area where you can park Event buttons that you intend to use in the Main Display area.
- **Main Display Area:** Area where you configure trigger and filter rules. You configure rules by dragging Event buttons from the Available Events area and then assigning actions to those buttons.
- **Config Status Indicator:** A button that indicates if the rule is valid or invalid. If a trigger or filter rule is configured correctly, the button is green and indicates Config is Valid. If a rule is not configured correctly, the button is red and indicates Config is Invalid.

Pop-Up Menus: When you right-click a button or area in the Generation Rules page, a context-sensitive pop-up menu appears that lets you do operations that relate to that button or area.

Properties Dialogs: When you click the Show/Hide Properties Dialog button for an event, action, or state, a dialog allows you to perform the same operations as in the pop-up menus.

Generation Rules Toolbar

The Generation Rules toolbar buttons control the Generation Rules page.

Figure 5.17: Generation Rules Toolbar

TABLE 5.13: Recording Rules Buttons

	New Event. Creates a new event in the Available Events area.		Zoom Out. Makes the display appear smaller.
	Delete Event. Deletes the selected event.		Show/Hide Channels. Shows or hides the channel icon on the Event button.
	Undo. Undoes the change made to Recording Rules page. The Undo buffer has unlimited size.		Show/Hide Properties Dialog. Shows or hides the properties dialog of the selected event, action, or state.
	Redo. Restores changes done to the Recording Rules page.		This display appears when the current Recording Rules configuration can be executed by the hardware.
	Zoom In. Enlarges the display (see note). There are five zoom levels. The default level is the middle one.		This display appears when the current Recording Rules configuration cannot be executed by the hardware.

Note: If you have a wheel on the mouse, you can zoom by holding down the CTRL key and rolling the mouse wheel.

Generation Rules Page: How It Works

You can think of the Generation Rules page as a workspace for creating rules (rules that determine how the analyzer generates traces). Rules are combinations of events and actions.

An event and the action or actions associated with it form a rule state.

Briefly, creating a rule involves the following steps:

1. Creating Event buttons in the Available Events area.
2. Drag-and-drop of Event buttons to the appropriate areas (cells) in the Main Display area.
3. Assigning an action or actions to each Event button.

Creating Event Buttons

To create a rule, first create one or more Event buttons. As you create Event buttons, they appear in the Available Events area. You then can drag-and-drop them into the Main Display area.

To create event buttons:

1. Click the **New Event** button at the left side of the toolbar to display the New Event pop-up menu.

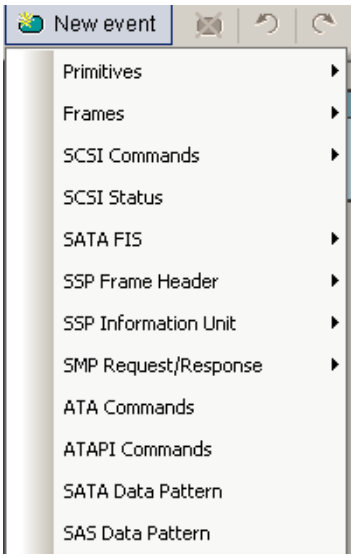


Figure 5.18: New Event Menu

2. Select an event, such as Primitive. The event appears in the Available Events area.

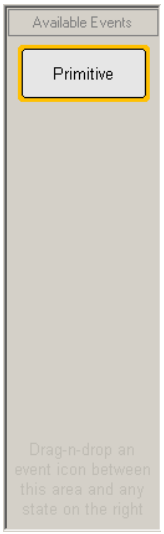


Figure 5.19: Available Events Area

Dragging a Button to the Main Display Area

After you create an Event button in the Available Events area, you can drag the button to the Main Display area and drop it in the appropriate cell (a cell is a grayed-out rectangle with a dashed line around it). You can think of each cell as a target for drag-and-drop of an Event button.

To drag-and-drop the Event button:

1. Place the mouse cursor on the Event button in the Available Events area. Click the left mouse button.
2. Drag the button to the cell. When the button is in the cell, a dashed highlight line appears around the cell. Drop the button in the cell (release the left mouse button). The Event button appears in the cell.

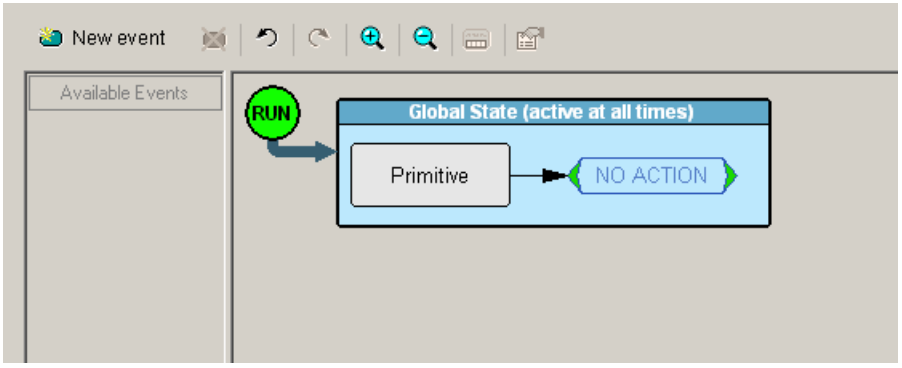


Figure 5.20: Event in Main Display

The default label for the first cell is Global State, which is active at all times.

Assigning an Action

After you have dropped the Event button in a cell in the Main Display area, you can assign an action to the event.

Note: If you do not assign an action to an Event button, the Generator ignores the event.

To assign an action to an Event button:

1. Right-click the **Event** button to display a pop-up menu.

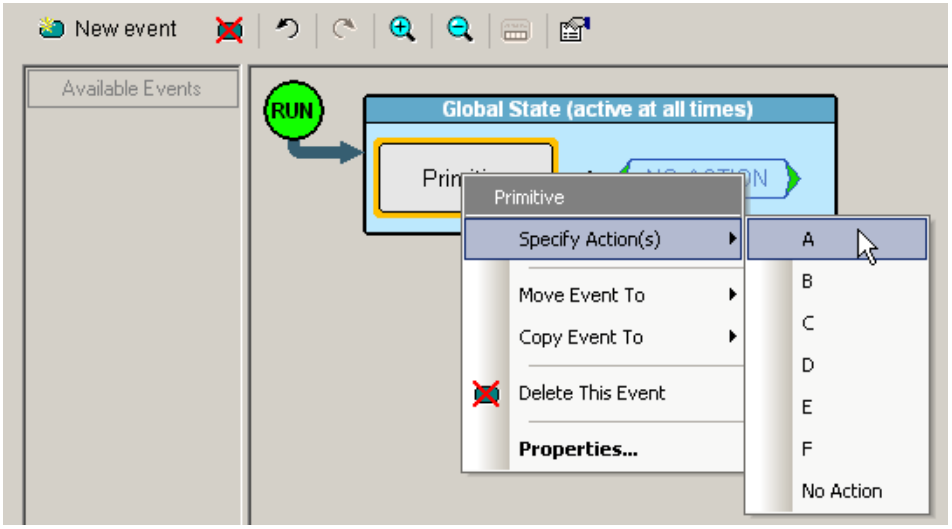


Figure 5.21: Action Menu

2. Select **Specify Action**, and then choose an action from the submenu. The menu closes, and the action is assigned.

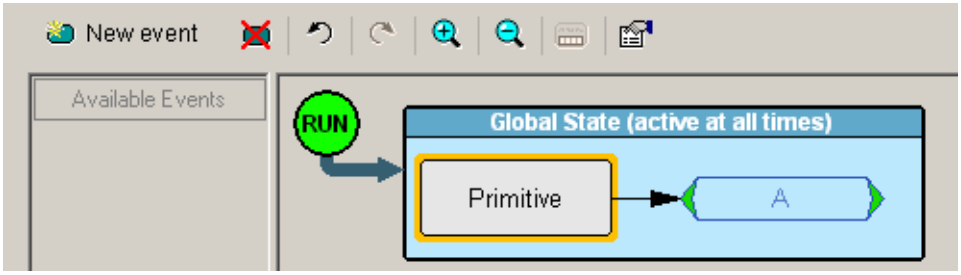


Figure 5.22: Action in Main Display

Note: You can also set actions within the Properties dialog for each event. Double-click the Event button to open the Properties dialog, then select the Actions tab and set your actions.

5.15.1 Generation Rules Pop-Up Menus

The Generation Rules window has context-sensitive pop-up menus that are associated with the following types of object: cells, events, and actions.

5.15.2 Cell Pop-up Menu

If you right-click a cell in the Main Display area that has an Event button contained in it, the Cell pop-up menu appears. The Cell pop-up menu has the following options.

- **New Event**: Displays the same menu that you get when you click the New Event button on the toolbar.
- **Properties**: Displays the Properties dialog for the selected cell.

5.15.3 Action Pop-up Menu

If you click an Action button in the Main Display area, the Action pop-up menu appears with the options **A** through **F** and **No Action**.

5.15.4 Event Pop-up Menu

If you click an Event button in the Main Display area, the Event pop-up menu appears. The Event pop-up menu has the following options:

- **Specify Action(s)**: Opens the Actions submenu, allowing you to assign an action to the event. Options on this submenu are the same as those on the Action pop-up, described previously.
- **Move Event to:** Moves the selected event to a different position in the Recording Rules window.
- **Copy Event to:** Copies the selected event to a different position in the Recording Rules window.
- **Delete This Event:** Deletes the selected Event. Alternatively, you can use the Delete button on the toolbar or keyboard to delete events.
- **Properties**: Displays the Event Properties dialog for the selected event.

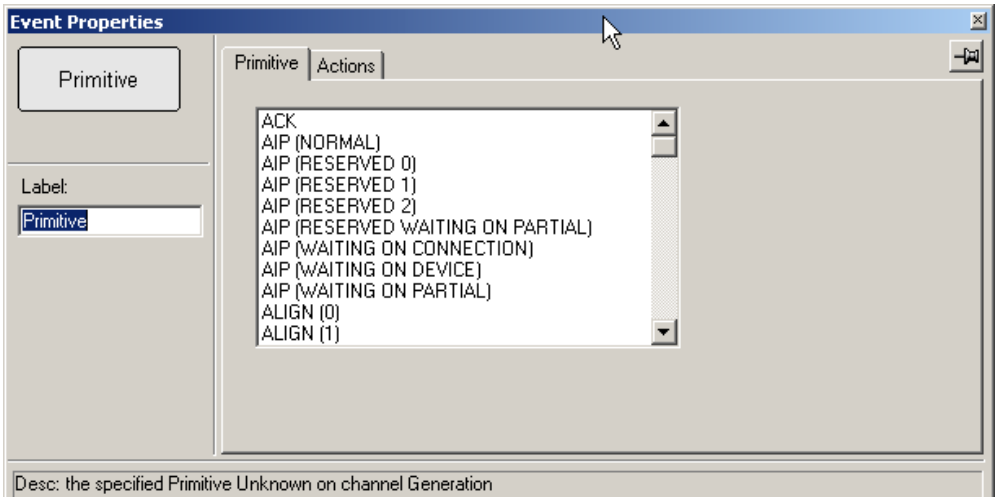


Figure 5.23: Event Properties

The dialog lists the Properties and their Values.

5.15.5 Events and Event Properties

Generation rules are associations between events and actions. These associations determine how trace recording occurs. The supported events are:

- **Primitives**: Primitive Categories or Primitive
- **Frames**: Open Address Frames, Identify Address Frames, Zone Broadcast Address Frames, SSP Frames, or SMP Frames
- SCSI Commands
- SCSI Status
- **SATA FIS**: Register Host to Device, Register Device to Host, Set Device Bits, DMA Activate, DMA Setup, BIST Activate, PIO Setup, Data, Route, or Vend FIS
- **SSP Frame Header**: DATA, XFER_RDY, COMMAND, RESPONSE, TASK, VENDOR, or RESERVED
- **SSP Information Unit**: Command IU, Task IU, XFER_RDY IU, or Response IU
- **SMP Request/Response**: RPT_GENERAL, RPT_MFG_INFO, DISCOVER, RPT_PHY_ERR_LOG, RPT_PHY_SATA, RPT_RT_INFO, CONFIG_RT_INFO, PHY_CONTROL, PHY_TEST_FUNCTION, CONFIG_PHY_ZONE, CONFIG_ZONE_PERM, RPT_ZONE_PERM, or RPT_ZONE_RT_TBL
- ATA Commands
- ATAPI Commands
- SATA Data Pattern
- SAS Data Pattern

Data Pattern Mask and Match

If you select Data Pattern as the Event, you can set Data Pattern event properties in the Event Properties dialog.

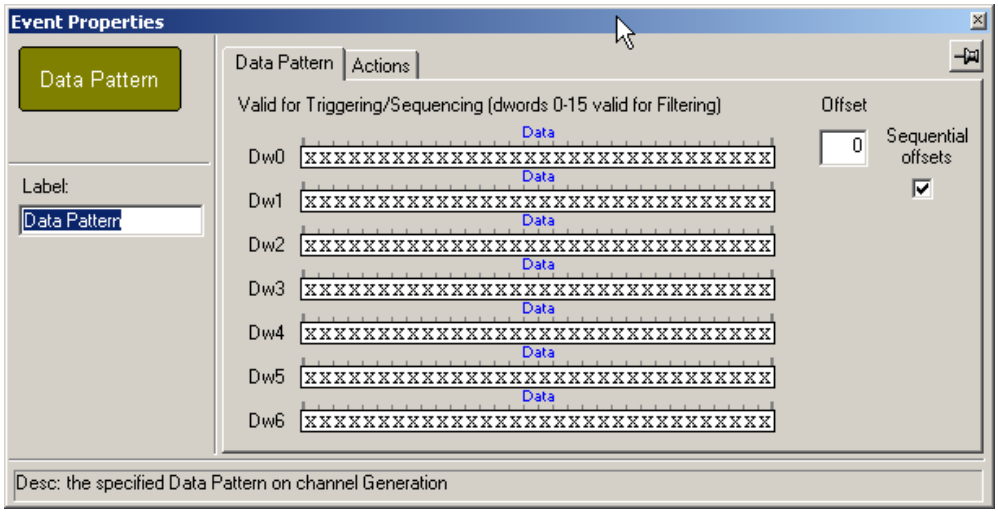


Figure 5.24: Event Properties for Data Pattern Event

In the Data Pattern dialog, you can set the DWORD. You can set the **Offset** by entering an integer. Optionally click the **Sequential Offsets** checkbox.

5.16 Setting Complex “Wait For” Conditions

The Generation Options dialog lets you define complex “Wait For” events and assign a letter value (“A” through “F”) to the definition, so that you can refer to the definition by letter instead of by textual name.

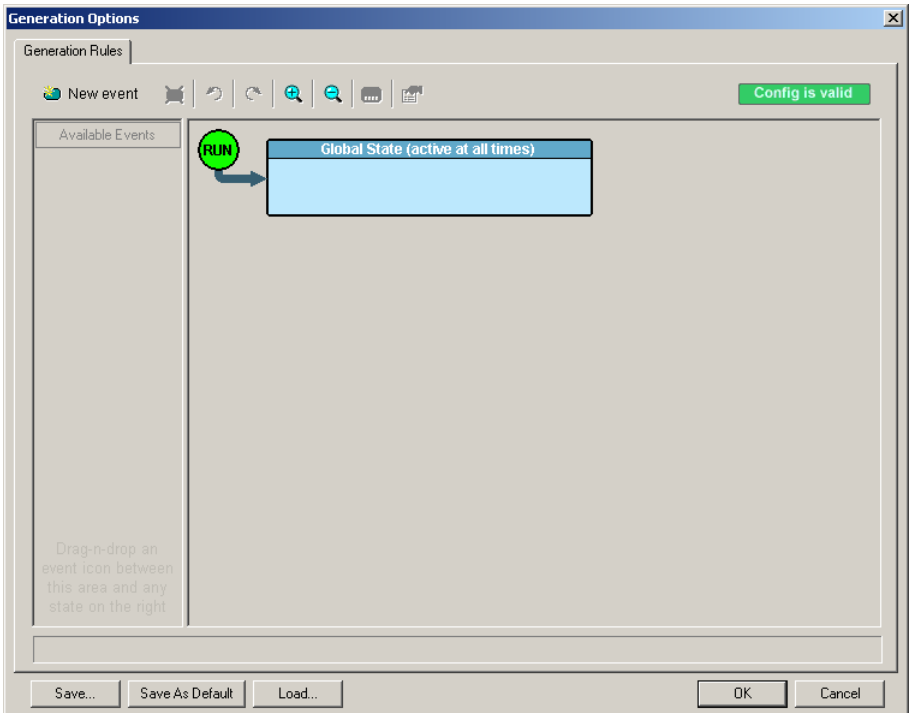
After a letter value has been assigned to an event, the letter is referred to in your generation script using the following command syntax:

```
Wait_For {WF_REC_RESOURCES_OUTPUT_A}
where “A,” in this case, is the defined condition.
```

5.16.1 Setting Conditions with the Generation Options Dialog

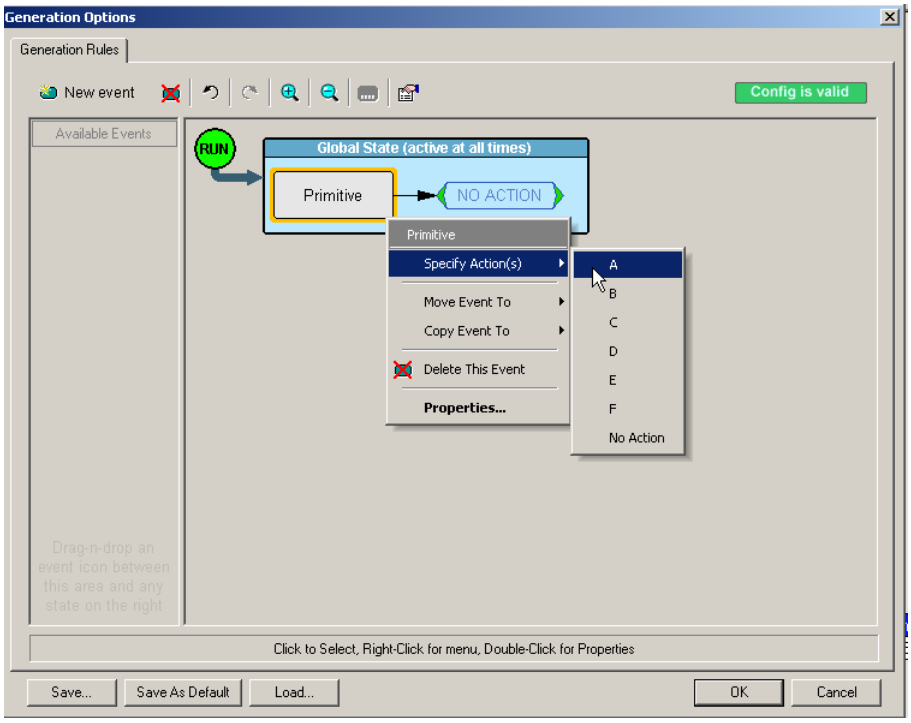
To set a complex condition, open the Generation Options dialog:

1. Select **Generate** > **Generation Options** from the menu to open the Generation Options dialog.

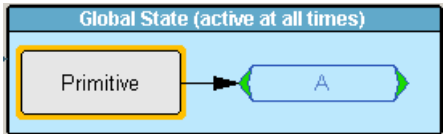


2. Click the **New Events** button and select an event from the menu. The selected event should appear in the **Available Events** area along the left side of the dialog box.
3. Drag the new event button to the **Global State** cell.

4. Right-click the new event button and select **Specify Action(s)**. A menu appears showing the letters A through F and the option “No action”.



5. Select a letter from the menu. The menu closes. The event button should now point to a neighboring button that has the letter value you assigned.



After the condition has been defined, you can then add the **Wait For** command line (with whatever letter you assigned) to your script.

For example:

```
Wait_For {WF_REC_RESOURCES_OUTPUT_A}
```

5.17 Find

Find allows searches on an open trace using one or more criteria. You can search by packet, transactions, split transaction, transfer, packet type, and fields within packets.

To run **Find**, select **Search > Find** or by click on the toolbar.

Searches can combine criteria using the options **Intersection** and **Union**.
Intersection creates AND statements such as “Find all packets with *x* and *y*.”
Union creates OR statements such as “Find all packets with *x* OR *y*.”

You can also perform searches in which packets or events are excluded from a trace, using the **Exclusion** option.

To perform a search:

1. Select **Find...** under **Search** on the Menu Bar.
   OR

   Click in the Toolbar.
   You see the User-Defined Find Events screen:

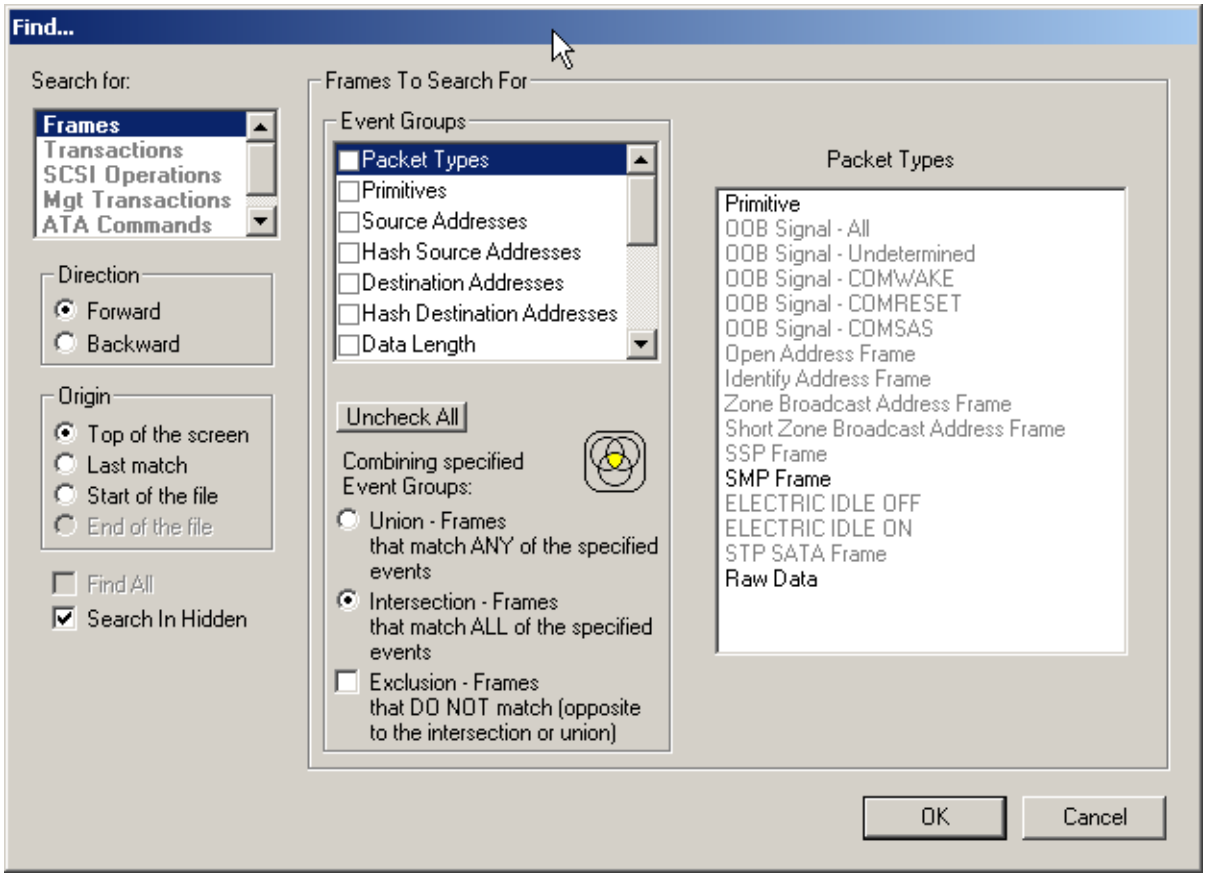


Figure 5.25: Find Dialog

2. Select **Frames, Transactions**, **SCSI Operations**, **Management Transactions, ATA Commands**, or **OOBs** from the top left list box to list that type of event in the Events Group box.
3. Select one or more events from the **Events Group** box:
   - ❑ Packet Types (Header, PHY, Event, Transaction)
   - ❑ Primitives
   - ❑ Source Addresses
   - ❑ Hash Source Addresses
   - ❑ Destination Addresses
   - ❑ Hash Destination Addresses
   - ❑ Data Length

- SMP Frames
- SSP Frames
- Errors
- FIS Types
- FIS Port Number
- Channel
- Data Pattern
- Completion Time

4. Select one of the following options:
   - **Union:** Find all packets matching ANY of the specified events.

   - **Intersection:** Find packets matching ALL of the specified events.

   - **Exclusion:** Exclude packets matching any of the specified events.

     Exclusion works with the other two options:
     Select Union *AND* Exclusion
     (=Exclude packets with ANY of the following fields) or
     Intersection *AND* Exclusion
     (=Exclude packets with ALL of the following fields.)

5. Optionally set the search **Direction** and **Origin**.
6. Optionally check to **Search in Hidden** or **Find All.**
7. Click **OK**.

After the search finishes, the program displays the packets meeting the search criteria.

5.17.1 Data Pattern Mask and Match

If you select Data Pattern as the Event Group in the Find dialog, you can set the Bitmask, Mask, and Match for each bit.

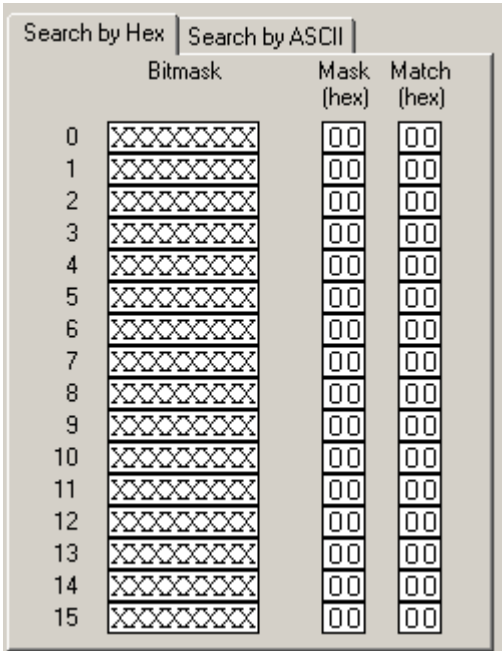


Figure 5.26: Data Pattern

Bitmask and Match always correlate. When you set Bitmask or Match. the other changes to maintain their correlation.

Note: If you set Bitmask/Match before setting Mask, the Mask changes to the default mask. You must change to the Mask that you want. If you set an appropriate Mask before setting Bitmask/ Match, the Mask does not change automatically to a default mask if you change Bitmask/Match.

5.17.2 Find Next

To apply the previous **Find** parameters to the next search:

- Select **Find Next** under **Search** on the Menu Bar.

  OR

- Click on the Toolbar.

5.17.3 Search Direction

Toggles the search forward or backwards. The current direction is indicated in the menu.

5.18 Display Options

You can select what information to display using the Display Options window.

To open the Display Options window:

- Select **Display Options** under Setup on the Menu Bar.

  OR

- Click on the Toolbar.

You can select Color/Format/Hiding, Level Hiding, and Headers display options. The following sections describe these display options.

Restore Factory Presets sets all Display Options values to the installed values.

5.18.1 Color/Format/Hiding Display Options

To modify the colors, formats, and hiding options, select the **Color/Format/Hiding** tab.

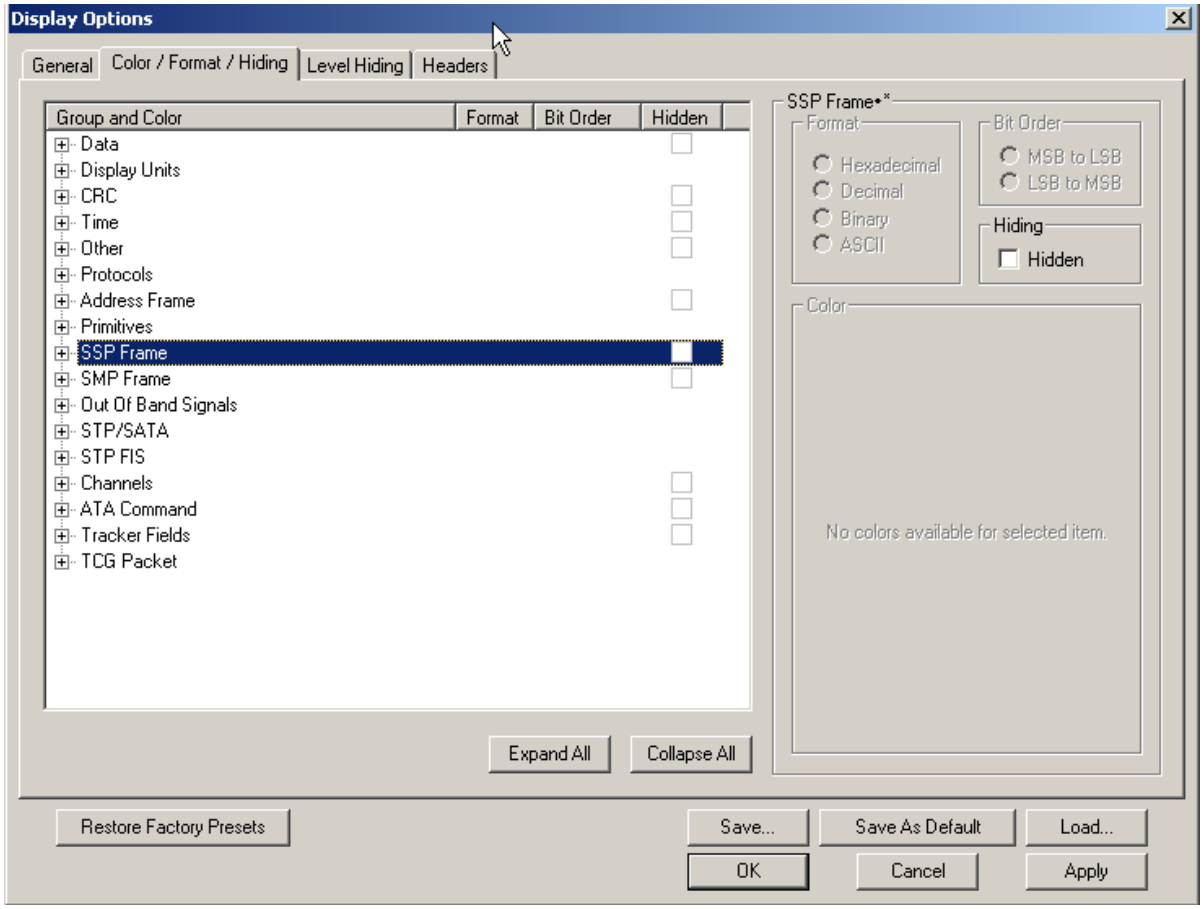


Figure 5.27: Display Options Dialog - Color, Format, Hiding Tab

5.18.2 Color Display Options

The program uses a default set of colors for each type of data in each group of data. The colors and color combinations are appropriate for most graphic systems. You can alter any color.

To specify a color for an information type, in the Color/Format/Hiding tab, select a row (such as Data) in the Group and Color column and expand it.

Select a data type (such as Data Length) in the Group, then select a color in the Color section, using Standard or Custom colors. Use a bright color for each important field.

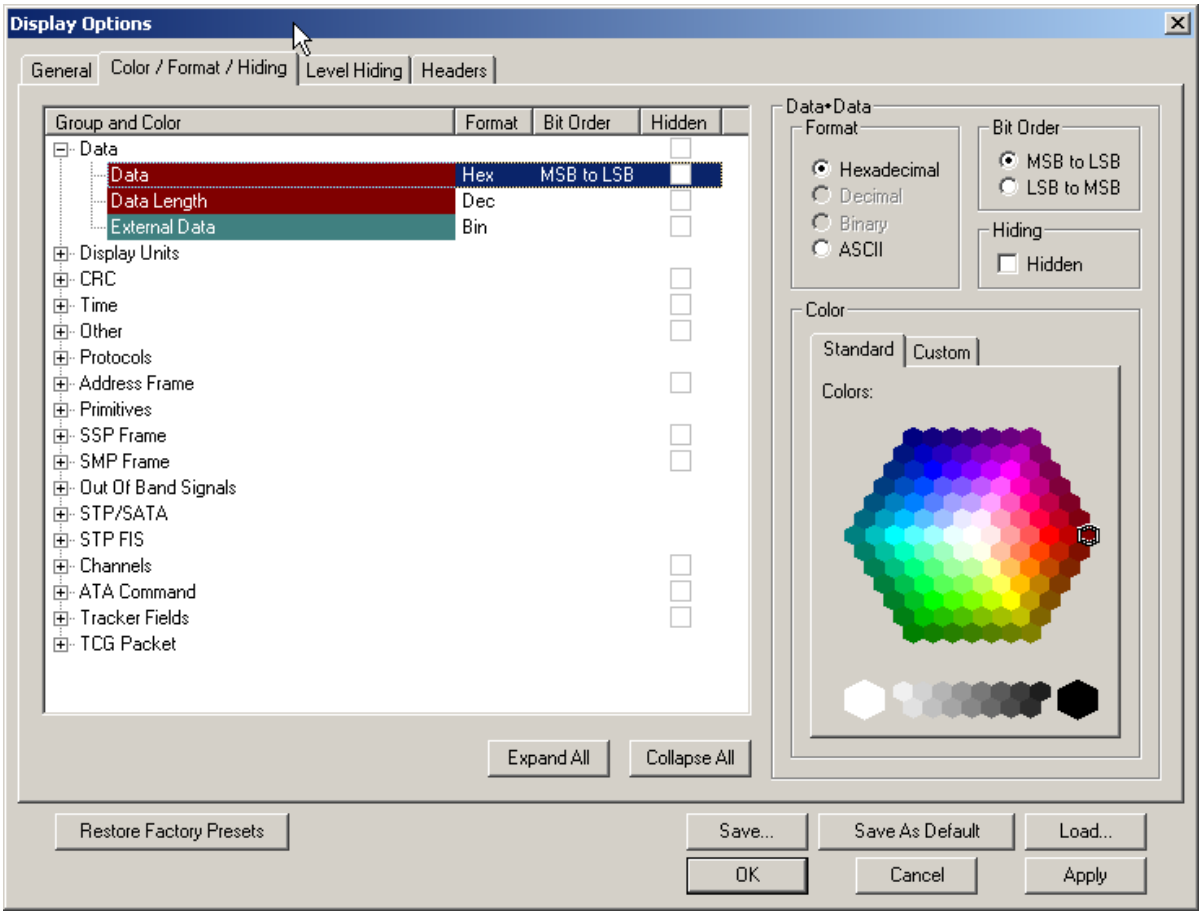


Figure 5.28: Display Options Dialog - Color

To customize colors, use the Custom tab.

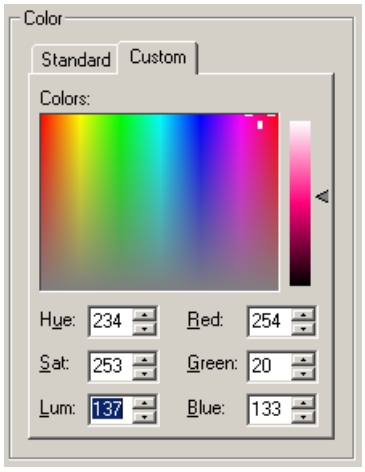


Figure 5.29: Custom Colors

Note: You cannot change the color of an Invalid Data (packet error) field. It is permanently set to red.

5.18.3 Formats Display Options

For each type of data in each group of data, the program has a default data format. Examples of number data formats are Binary, Decimal, and Hexadecimal. An example of a text data format is ASCII.

To specify a data format for an information type, in the Color/Format/Hiding tab, select a row (such as Data) in the Group and Color column and expand it.

Select a data type in the Group.

Select a format in the Format section. The following formats are available.

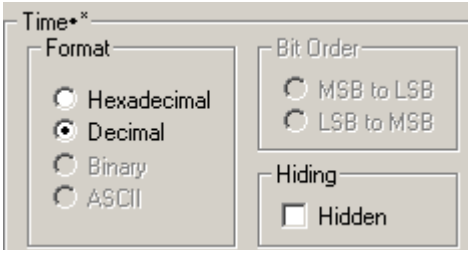


Figure 5.30: Formats

If available, select **Bit Order** in the Format section. The options are MSB to LSB or LSB to MSB.

5.18.4 Hiding Display Options

By default, no data is hidden. You can hide any group of data and any type of data.

To hide one or more fields, select the Group and Data type in the Group and Color column, then click the **Hidden** checkbox in the display or the **Hidden** checkbox in the Hiding section of the Format section.

5.18.5 Level Hiding Options

By default, nothing is hidden. You can hide:

- Packet Types
- Primitives
- Source Addresses
- Destination Addresses
- Data Length
- SMP Frames
- SSP Frames
- Channels
- FIS Types
- FIS Ports
- Gen Global Settings

Select the **Level Hiding** tab, then select the data types to hide.

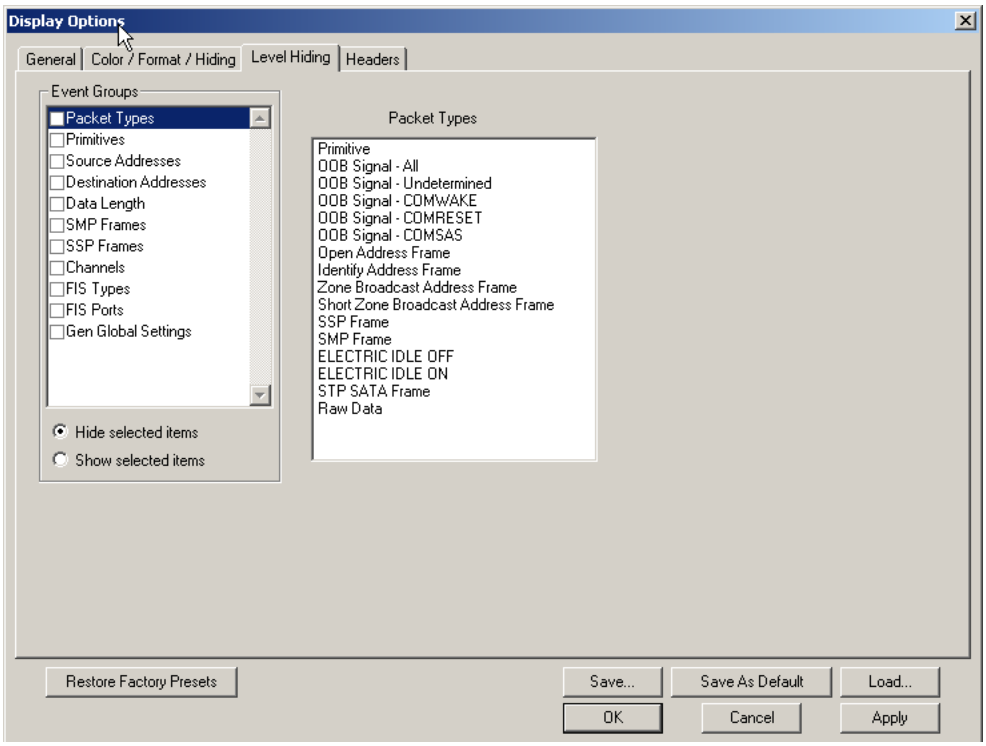


Figure 5.31: Level Hiding Tab

You can select to **Hide selected items** or **Show selected items**.

5.18.6 Headers Options

You can choose the appearance of header fields. Select the **Header** tab, then select the header.

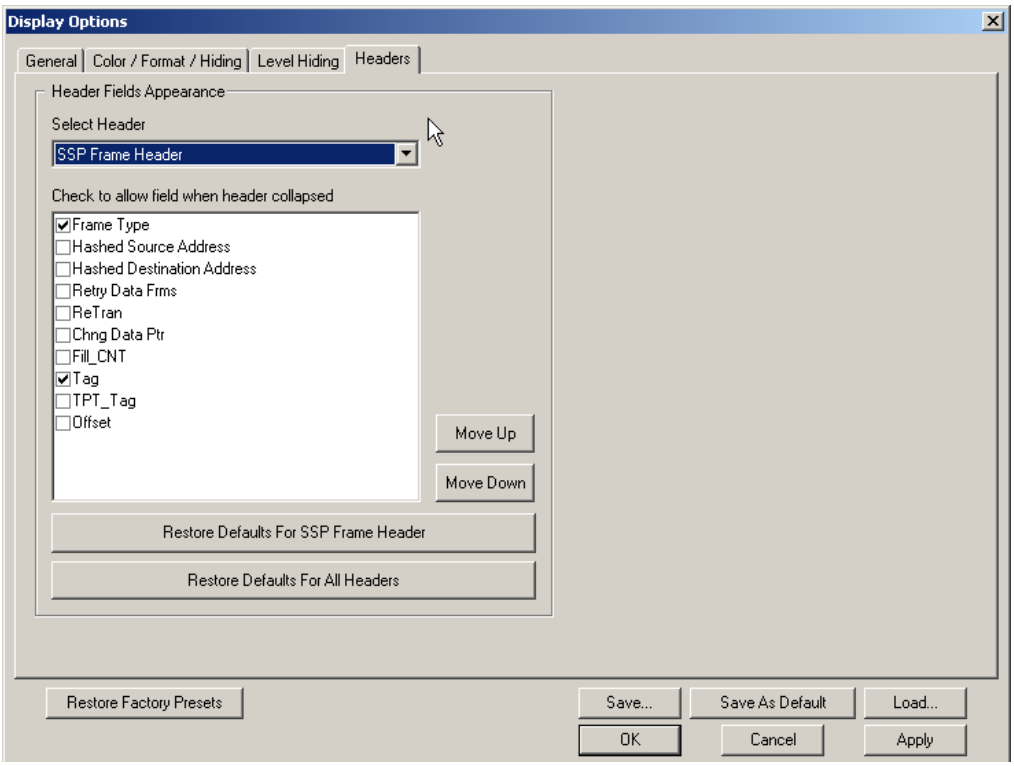


Figure 5.32: Level Hiding Tab

Available headers are:

- SSP Frame Header
- SMP Report General (Request or Response)
- SMP Report Mfg Info (Request or Response)
- SMP Discover (Request or Response)
- SMP Report Phy Error Log (Request or Response)
- SMP Report Route Info (Request or Response)
- SMP Configure Route Info (Request or Response)
- SMP Phy Control (Request or Response)
- SMP Phy Test Function (Request or Response)
- SMP Configure Phy Zone (Request or Response)
- SMP Configure Zone Permission (Request or Response)
- SMP Report Zone Permission (Request or Response)
- SMP Report Zone Routing Table (Request or Response)
- STP Register Host to Device FIS
- STP Register Device to Host FIS
- STP Register Device Bits Device to Host FIS
- STP DMA Activate Device to Host FIS
- STP DMA Setup FIS

- ❑ STP BIST Activate FIS
- ❑ STP PIO Setup Device to Host FIS
- ❑ STP Data FIS
- ❑ STP Frame Summary Header
- ❑ SATA Frame Summary Header
- ❑ SAS Delta Time

Check boxes to allow a field when the selected header is collapsed. Example header fields are:

- ❑ Frame Type
- ❑ Function
- ❑ Result
- ❑ Offset
- ❑ FIS Type

You can move items up and down.

You can select to **Restore Defaults** for the selected header or all headers.

5.18.7 Saving Display Options

You can save a set of Display Options values, make a set the default settings, or use a saved set of values with the commands at the bottom of the **Display Options** window:

- ❑ To save the current Display Options values in an options file for use in future sessions, click **Save**. Enter a file name without a file name extension. The program adds the **.opt** extension. (The file must have an **.opt** file name extension.)
- ❑ To load a previously saved **.opt** file, click **Load** and select a file name.
- ❑ To save the current Display Options values in the **default.opt** options file for use as the default display options, click **Save as Default**. (Do not delete the **default.opt** file.)
- ❑ To apply the current Display Options values, click **Apply**. The Display Options window remains open.
- ❑ To apply the current Display Options values and close the Display Options window, click **OK**.
- ❑ To cancel unsaved changes to display values and exit the Display Options window, click **Cancel**.

5.19 Connection Parameters

To display the connection parameters (see Figure 5.33 on page 465), select **Generate > Connect Parameters**.

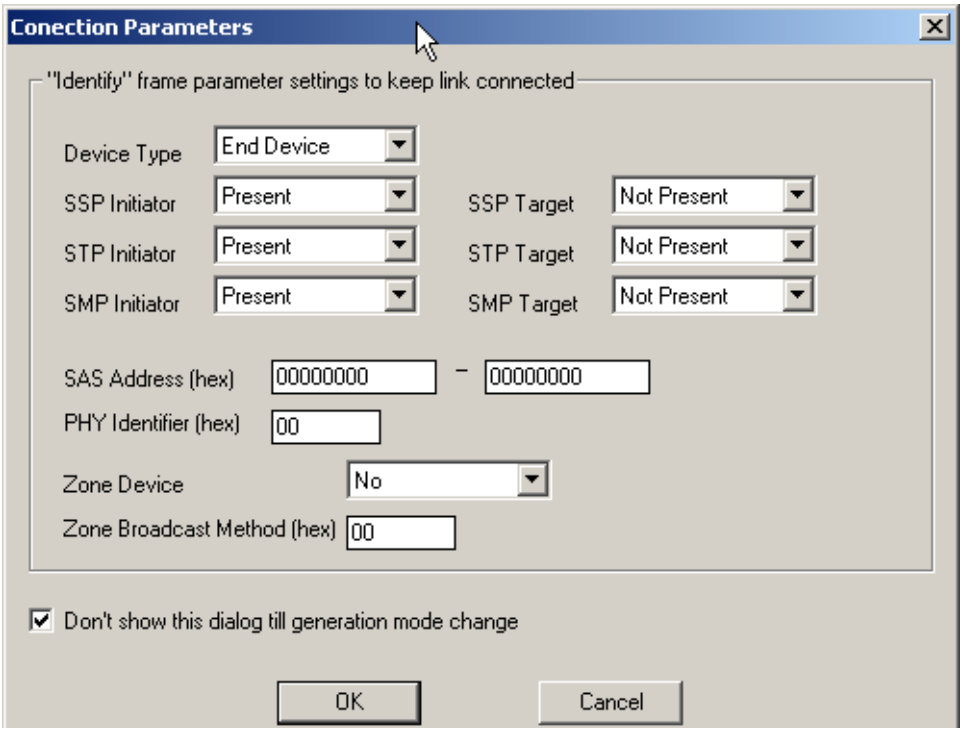


Figure 5.33: Connection Parameters Dialog

You can set the “Identify” frame parameter settings to keep the link connected:

- **Device Type**: End Device, Edge Expander, or Fanout Expander
- **SSP Initiator**: Present or Not Present
- **STP Initiator**: Present or Not Present
- **SMP Initiator**: Present or Not Present
- **SSP Target**: Present or Not Present
- **STP Target**: Present or Not Present
- **SMP Target**: Present or Not Present
- **SAS Address (hex)**: eight digits - eight digits
- **PHY Identifier (hex)**: two digits
- **Zone Device**: Yes or No
- Zone Broadcast Method (hex): two digits

You can select to not show the dialog until there is a generation mode change.

5.20 Resetting the Toolbar

The Analyzer Toolbar has the following:

- **Show InFusion Frame**: Switches to InFusion frame.
- **Show Analyzer Frame**: Switches to Analyzer frame.
- **Start Analyzer**: Start Analyzer without switching to Analyzer frame.
- **Stop Analyzer**: Stop Analyzer without switching to Analyzer frame.
- **Abort Analyzer**: Abort Analyzer without switching to Analyzer frame.

The Generator Toolbar has the following:

- **Start Generation**

- **Stop Generation**
- Resume Generation
- Connect Link
- Disconnect Link
- Generation Options

From time to time (such as following a software upgrade), it is possible for the buttons on the toolbar to not match their intended function. You can reset the toolbar by performing the following steps:

1. Select **View > Toolbars** from the menu bar.
2. Select **Customize** from the submenu to display the Customize dialog box.

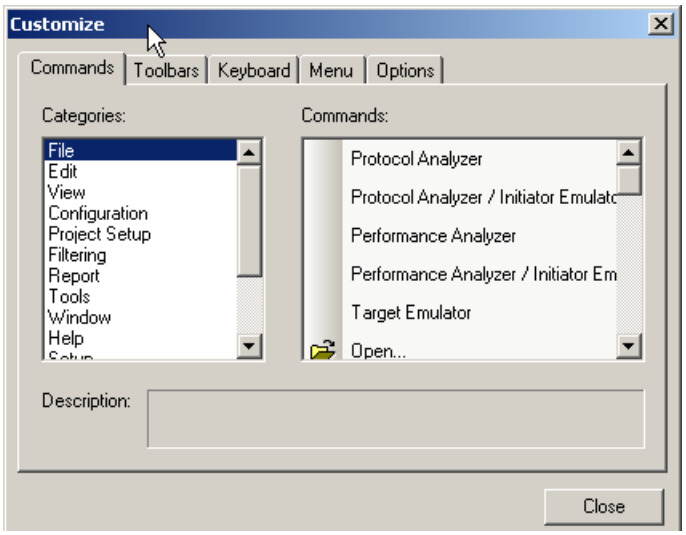


Figure 5.34: Customize Commands

3. Select the **Toolbars** tab to display the Toolbars page of the Customize dialog box.

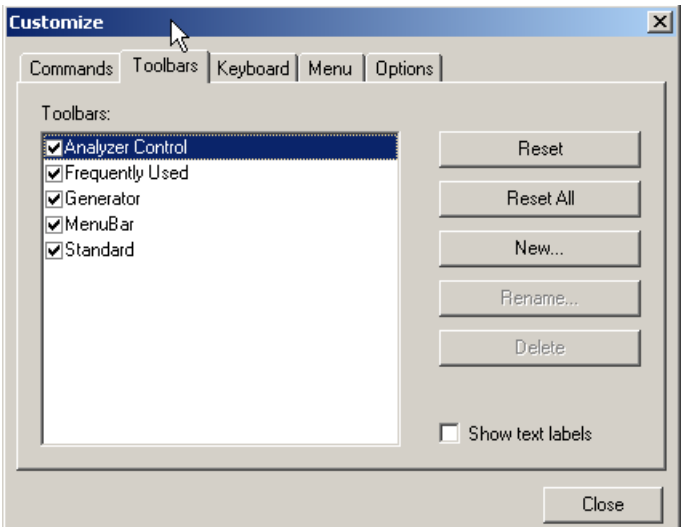


Figure 5.35: Customize Toolbars

4. Click the **Reset All** button.
   The toolbar resets to the factory defaults.

Appendix A

Creating a Pattern Generator File

You may use any text editor or word processor to create a pattern generator file (*.spg) using the following conventions:

6.1 Key words

ALIGN, CONT, DMAT, EOF, HOLD, HOLDA, PMACK, PMNAK, PMREQ_P, PMREQ_S, R_ERR, R_IP, R_OK, R_RDY, SOF, SYNC, WTRM, X_RDY, XXXX, LOOP, Enable, Disable, Host, Device, Scramble, Role, END_OF_FILE.

6.2 Comment format

```
/*Comment text*/
```

6.3 Primitive definition format

To add an ALIGN primitive, use ALIGN or 27.3 10.2 10.2 K28.5

To add a CONT primitive, use CONT or 25.4 25.4 10.5 K28.3

6.4 Loop definition format

You may write a defined pattern into memory repeatedly by enabling a loop.

Loop definition allows either “Enable” or Disable”. To enable looping use: Loop=Enable

6.5 Scramble definition format

Scramble definition allows either “Enable” or Disable”. To enable scramble use: Scramble=Enable

6.6 Role definition format

To specify SATA hardware role: Role=Host or Role=Device

6.7 END_OF_FILE definition

A pattern generator file must include END_OF_FILE as the last statement in the file.

6.8 Example Pattern Generator File

Figure A-1 illustrates a typical Pattern Generator file.

```
/*……Set Device Bits……*/
/*Device*/
23.2 23.2.21.5 K28.3                /*X_RDY*/
23.2 23.2.21.5 K28.3                /*X_RDY*/
25.4 25.4.10.5 K28.3                /*CONT*/
XXXX
XXXX
XXXX
XXXX
XXXX
XXXX
XXXX
23.1 23.1 21.5 K28.3                /*SOF*/
00 50 40 A1
E0 00 00 00
21.6 21.6 21.5 K28.3                /*EOF*/
24.2 24.2 21.5 K28.3                /*WTRM*/
24.2 24.2 21.5 K28.3                /*WTRM*/
25.4 25.4 10.5 K28.3                /*CONT*/
XXXX
XXXX
XXXX
XXXX
21.5 21.5 21.4 K28.3                /*SYNC*/
21.5 21.5 21.4 K28.3                /*SYNC*/
25.4 25.4 10.5 K28.3                /*CONT*/
XXXX
XXXX
XXXX
XXXX
Role=Device
Loop=Enable
Scramble=Disable
END_OF_FILE
/*……..*/
```

Figure A.1: Sample Pattern Generator File *spg

Appendix B

China Restriction of Hazardous Substances Table

The following tables are supplied in compliance with China's Restriction of Hazardous Substances (China RoHS) requirements:

	有毒有害物质和元素					
部件名称	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
PCBAs	X	O	X	X	X	X
机械硬件	O	O	X	O	O	O
金属片	O	O	X	O	O	O
塑料部件	O	O	O	O	X	X
电源	X	X	X	O	X	X
电源线	X	O	X	O	X	X
保护外壳(如有)	O	O	O	O	X	X
电缆组件(如有)	X	O	X	O	X	X
风扇(如有)	X	O	X	O	X	X
交流滤波器和熔丝组件(如有)	X	O	X	O	O	O
外部电源(如有)	X	X	X	O	X	X
探头(如有)	X	O	X	O	X	X
O: 表明该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求之下。						
X: 表明该有毒有害物质至少在该部件的某一均质材料中的含量超过 SJ/T11363-2006 标准规定的限量要求。						

EFUP (对环境友好的使用时间) 使用条件:
温度: 5摄氏度到40摄氏度
湿度: 5% - 95%最大相对湿度 (无冷凝)
高度: 最高2000米

	Toxic or Hazardous Substances and Elements					
Part Name	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr^{6+})	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
PCBAs	X	O	X	X	X	X
Mechanical Hardware	O	O	X	O	O	O
Sheet Metal	O	O	X	O	O	O
Plastic Parts	O	O	O	O	X	X
Power Supply	X	X	X	O	X	X
Power Cord	X	O	X	O	X	X
Protective Case (if present)	O	O	O	O	X	X
Cable Assemblies (if present)	X	O	X	O	X	X
Fans (if present)	X	O	X	O	X	X
AC Filter/Fuse Assy (if present)	X	O	X	O	O	O
Ext Power Supply (if present)	X	X	X	O	X	X
Probes (if present)	X	O	X	O	X	X
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement specified in SJ/T11363-2006.						
X: Indicates that this toxic or hazardous substance contained in at least one of the homogenous materials used for this part is above the limit requirement specified in SJ/T11363-2006.						

EFUP (Environmental Friendly Use Period) Use Conditions:

Temperature	5C to 40C
Humidity	5% to 95% max RH (non-condensing)
Altitude	Up to 2000 meters

7.1 WAN Operation

WAN connected operation is supported. Contact factory for details of operation. Refer “How to Contact Teledyne LeCroy” on page 471 for contact information.

Appendix C

How to Contact Teledyne LeCroy

Type of Service	Contact	
Call for technical support	US and Canada:	1 (800) 909-7112
	Worldwide:	1 (408) 653-1260
Fax your questions	Worldwide:	1 (408) 727-6622
Write a letter		Teledyne LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054-3115 USA
Send e-mail		psgsupport@lecroy.com
Visit Teledyne LeCroy's web site		teledynelecroy.com/

Index

Symbols

.cfg file 292
.infdb file 340
.sac files 47
.stg files 44, 387

Numerics

10 bit payload data display 277
10-pin connector 24
8 bit payload data display 277

A

Abort Analyzer button 392
About 312, 392
Action 338
  button 452
  pop-up menu 452
action
  counter 350
  scenario 348
Action Properties dialog 350
actions
  assigning 451
  events 451, 453
Actions submenu 452
Activate Device button 197, 204
Activation 200
Active Device command 197
Add Device... 28
Add Pattern button 113
Add to Trigger 207
address 471
address frame 70
Address Frame Type Pattern dialog 70, 92
Address FramesDecl.inc 402
Advanced button 153
Advanced Host Settings 158
Advanced Initiator Settings 153
Advanced Mode 35, 111
Advanced Settings 194
Affiliation 142
affiliation setting 142
alias name 322
ALIGN Transmission Period 105
Analysis Project dialog 53
analyzer
  connecting 21
analyzer overview 17
Anchor the Selection bar 302
Any Trigger mode 79
application overview 35
As previously saved 298
Ask user to close the previous captured sample before running the new project 297
assigning actions 451
Asynchronous notification 204
Asynchronous signal recovery 160
ATA Command 120
ATA Command Pattern dialog 87, 98
ATA Command Report 224
ATA Commands Error Setting dialog 187
ATA Commands icon 187
ATAPI Pattern dialog 88
ATAPI Report 225
ATAPI spec assignment 297
Auto Run 20, 103
Auto Update LBA 146
Auto Update LBA check box 140
AutoAlign 399
Autostop exerciser when Analyzer Stopped 152, 157
Available Events Area 447

B

Based on Cell Type 302
Based on Port No. 302
Based on Read/Write Command Type 302
Based on Specific Command Type 302
batch command editing 379
batch script 377

Batch Script Setting 330
Beep statement 385
BIST (FIS) 76
bookmarks 258
  finding 259
Break Link Recovery 328
Browse Default Path 297
buffer
  % full 285
Buffer Starvation 179
bus condition report 224
Bus Conditions dialog 84
Bus Utilization
  buttons 243
Bus Utilization View 242
buttons
  bus utilization 243
  Main toolbar 392
  Script Editor 404
Buzzer check 319
Byte Order 282
Bytes in Column 291

C

cables
  usage 22
Cancel button kills upload immediately 299
capture
  parameter 64
  pre and post trigger 65
Capture tab 49
Capture tab for Pattern 63
cascading 23
cascading STX-430's & STX-460's 23
CATC Script Language 252
CATC Technical Support 471
cell address 164
Cell pop-up menu 452
cells 450
  highlight 450
Check for Updates 312, 392
Choose Port Speed 106
Choose SATA Signature Content 190
Click here to add another script command 379
Click here to add script command 378
Clock check 313
Clock ports 23
Close Connection Definition 182
Close Connection dialog 182
Close Connection Setting 141, 146
Close previous sample file when new sample file opens 299
Code violation and Disparity 180
Code Violation and Disparity error 185
Code violation and Disparity error 143, 148, 150, 188
Code Violation and Disparity errors 191
Code violation and Disparity errors 178
Collapse All 283, 284
Collapse Log button 253
color 291
colors
  Display Options 460
column
  hiding 239
  rearrange 216
  resize 216
column content
  filtering 237
  sorting 239
Column View 41
column view 215
Column View Memory Size 303
Column View Packet Size 303
Columns in Row 291
Combined Event 338
Command Parameters dialog 378
Command Properties dialog 378
Commands Error Setting dialog 182
Compact 391
compensate
  for line loss 294
Complex "Wait For" Conditions 454
compliance test 323
Compliance Test dialog 323
components 18
conditional statements 380
Config Status Indicator 447
configuration 288
Configuration menu (InFusion) 330
Configure Device 330
Connect Link 389
Connect Link button 392
Connect Parameters 389
Connect Parameters command 464
Connection Management icon 180
Connection Management Setting dialog 180
Connection Parameters dialog 464
Connection Rate 140, 145
CONT Usage 157
contact 471
Convert 388
Convert port configuration without prompt for confirm 297
Copy Event to option 452
copying events 452

Count Randomly 350
counter
as data 164
Counter button 164
Counter Value 350
counters 350
Create statistical report read/write page 299
Current License Configuration field 305
cursor position status bar 286
cursors
locating 257
positioning 287
timing 219
Customize
command 466
dialog box 466

D

data
pattern 67
show 283
Data (FIS) 77
data block
counter data 164
custom pattern 163
defining 161
editing 163
editing as text 166
naming 163
random pattern 165
walking bit 165
Data Block dialog box 161
Data Block Edit menu 163
Data Block icon 134
Data Block Name list 166
data blocks 134
data format 282
Data Pattern dialog 67, 89
Data Pattern edit box 163
Data Pattern Mask and Match 453, 458
Data Payload View 244
data report 243
Data Report button 243, 247
Data View 41
DataPatternCapture 207
Decode CDB of Commands 302
Decode Toolbar 279
Decode toolbar 43
Default Data Block button 161
Default Workspace 297, 298
default workspace 297
default.infdb file 340
Defer Handshake 144, 149
Defer Handshake Errors 186, 190
Define different patterns for pre-trigger and post-trigger data captures 50
Define Pattern dialog 163
defining patterns 100
Delay in HOLD Response 178
Delay in sending frame 142, 148, 185, 188
Delay instruction 132
Delete button 452
Delete This Event option 452
deleting events 452
Destroy Field of Frame 185, 189
Device Activation 194
device emulation 174
Device Emulator 36
device emulator
settings 197
Device Emulator Settings dialog 197
Device Identifier dialog 135, 321, 322
device library 341
Device Library window 341, 376
Device Setup dialog 307
Device Sleep 213
Device Type field 465
DHCP server 34
direction
search 390, 458
Disconnect 27
Disconnect Link 389
Disconnect Link button 392
disparity indication 279
display
fonts 292
display Configuration 288
display configuration 288
Display License Information 310
display manipulation 207
Display Options 389
Color/Format/Hiding tab 459
factory settings 459
level hiding 462
loading 464
saving 464
values 459
window 459
Display pre-filtered cells as blank in column view 303
DMA activate (FIS) 75
DMA setup (FIS) 76
Don’t care (Snapshot) 78
Don’t check credit 148, 178, 185
downloading a scenario 376
dragging buttons 450
Drop Length for ... ms 150
Drop link after ... ms for ... ms 179
Drop link for ... ms 179

DWORD Matcher 347

E

Easy Mode 35
Edit as Text button 392
Edit Comment 388
Edit script 256
e-mail 471
Email CATC Support 471
Enable Outlining command 404
Enable Tooltip box 291
Entire Memory 103
error
  connection management 180
Error Injection 328
Error Injection tab 175
error log 405
error message
  startup 20
errors 380
  SAS commands 187
Ethernet
  connecting with 34
Ethernet port 19
Event 338
event
  counter 350
  scenario 344
Event button 127
Event buttons
  creating 449
  dragging 450
Event pop-up menu 452
Event Properties dialog 452
events 453
  actions 451, 453
  buttons 449
  copying 452
  deleting 452
  moving 452
Events Group box 456
example files 61
exclude from capture
  Align 50
  Idles 50
  Notify 50
  OOB Signals 49
  patterns 64
  Payload of Data Frame 49
  RRDY 50
  SATA_CONT 49
  SATA_SYNC 49
  XXXX 49
Exclude Idle checkbox 65
Exclusion search 457
exercise
  specific addresses 134
Expand All 283, 284
Expand Log button 253
expandability 23
Expanded Waveform View 219
Expansion Card Data Status or Clock Status check 318
Expansion module 19
Expansion ports 23
Export 388
Export command 138
Export Paired SAS Address Report 59
Export Read/Write Command Report 59
Export to Excel button 235
Export to Initiator Emulator 56, 57
External Trig In Setting 307
External Trig Out Setting 106, 306
External Trig Setting 330
External Trig Setting dialog 306
external trigger 19
External Trigger dialog 83
External Trigger Out 145
External Trigger out combo box 140
Extract Sample File dialog 57, 138

F

fax number 471
features 19
field
  show/hide 280
Field List Settings 303
Field of Frame 143, 148
Field Settings 290
Field View 217
file library 340
File Manager 340
File Menu 388
File menu (InFusion) 330
file type
  definition 60
files
  .utg 44, 387
  tabs 405
Fill reserved fields with 143
filter 261
  by tag number 267
  check condition 266
  options 265
  save setup 263
  type 263
filter enable 270
filter idle 256, 271
filtering 261
  direction 263
filtering column content 237

Filtering menu 261
filters 447
Find
  command 456
  utility 455
Find and Replace button 392
Find button 392
Find command 390
Find Device 320, 322
Find Device button 321
Find New Device command 134
Find Next 390
Find Next command 458
first burst 142
  enable 147
FIS Pattern dialog 91, 97
FIS Patterns dialog 69
FIS Report 232
FIS Type dialog 72, 96
Fit to Graph Area 243
Floating License dialog 305
format
  display options 461
Found Device List Mode 297
FPGA 1 or 2 Serdes Chip 315
Frame button 126
Frame Inspector View 217
Frame Length Error 143, 148, 150, 178, 180, 185, 188, 191
frame settings
  incoming ATI 144
  incoming SCSI 149
  outgoing ATI 142
  outgoing SCSII 147, 184, 188
Frame Type 148
Frame Type Error 142, 147, 150, 180, 185, 188
frames
  hide 240
From Initiator 342
From Target 342

G

General Errors dialog 175
general report 223
Generate Error On area 142
Generate Menu 389
Generate Periodic Error 177
Generating Traffic 393, 407
Generation Commands 422
Generation Files 394
Generation Language 408
Generation Options 389
Generation Rules 447
Generation Rules page 447
Generation Rules toolbar 448
Getting Started manual 18
Gigabit Ethernet interface 34
Global Rules 338
  examples 353
Go to ATA/SCSI Cmd. 243
Go To button 256
Go to command 390
Go to Event 390
Go to Event dialog 390
Go to Marker 390
Go To Timestamp dialog 258
Goto Command 281
Goto instruction 130
Goto Label statement 381
Goto Response 281
Goto Within Packet command 282
grouping
  by port 104

H

Handshake Error 144, 149, 186
Handshake Errors 190
hardware
  run 51
hardware setup 21
Hash Address Utility 391
Hashed Address field 391
Help Menu 392
Help Topics 309, 392
Hide All Primitives 257
Hide RRDY Primitives 256
Hide Unassociated Traffic 256
hiding
  display options 462
  levels 462
hiding options 462
Histogram View 41
histogram view 240
Host Emulator 119, 156
Host Emulator Port 156
Host Emulator Setting dialog 156

I

Identify Error Setting dialog 180
Identify frame parameter settings 465
Identify icon 180
If instruction 131
IfIsStopped statement 380
Ignore XRDY/RRDY sequence 178
Include statement 405
Incoming Frame Setting dialog 149

Incoming Frame Settings 181, 186, 189
Incoming Frame Settings dialog 144, 186, 189
Incoming Open Primitive Response 141, 147
InFusion 327
Infusion 44
InFusion scenarios 336
initiator
  add a frame 126
  add an event 127
  add ATA command 120
  add program lines 120
  add SCSI command 122
  add SMP command 125
  add Task command 124
  adding commands 120
  exercise specific addresses 134
  program instructions 129
  programming 119
Initiator Emulation 393
Initiator Emulator 119, 152
Initiator Setting tab 150
Insert ATA Command button 120
Insert Event button 127
Insert Frame 143, 148, 186, 189
Insert Frame button 126
Insert Instruction button 130
Insert Primitive 143, 148, 150, 178, 185, 189, 191
Insert SCSI Command button 122
Insert SMP Command button 125
Insert Task Command button 124
Install component selection 20
Installation CD ROM 18
Instruction button 130
Inter-FPGA Connection 317
Inter-reset Delay Settings 160
Intersection search 457
IP Settings... 28

J

Jammer 333
Jump to Next button 237
Jump to Previous button 237
Jump to Specific button 237

K

K-Codes 347
key sequences 118

L

label 133
lanes report 229
launching 35
Launching the CrossSync Control Panel 53
LCD display 20
LED check 319
LEDs
  description 19
library 340
  device 341
  main 340
License Configuration 305
License Manager 305
line condition 345
line numbers 404
link layer
  command interpretation 52
Link Script Selection dialog 406
Link With Sample View 237
Load command 464
Load dialog 166
log
  error 405
log file 380
Loop End instruction 130
Loop Start instruction 130

M

MAC address 25
Main Display Area 447
Main FPGA tab 317
Main Library window 340
Main Window 47
Manual Trig button 79
manual trigger 79
Maximum Number of Uploader Threads 297
Memory Assignment 303
memory check 314
Memory Size 103
Move drop-down list 237
Move Event to option 452
moving events 452
Multi Sequencer check box 115
MUX Setting 109
MUX Setting dialog 109
Muxing 109

N

NCQ commands 203
NCQ Commands Time out Threshold 297
network 34
Networks... 28
New Batch Script command 329
New Event
  button 449
  option 452
  pop-up menu 449

New GenFile 388
New Protocol Analyzer Project in Advanced Mode 296
New Scenario button 341
New Scenario command 329
New script 256
No WTRM 178
normal zoom
reset 257
Notes tab 110
Number of Run text box 103
Number of Runs Each Test 314

O

OOB Signal Setting 195
OOB Signal Setting tab 154, 159
Open as Data Vie 244
Open Connection Definition 181
Open Connection dialog 181
Open Document button 392
Open Frame Setting dialog 141, 146, 181
Open Library command 329
Open Sample file In 298
operating system 20
opt files 464
order reorder
in results display 277
Others Report view 226
Outgoing FIS Command Error 177
Outgoing Frame Command Error 177
Outgoing Frame Setting dialog 147, 149, 184, 188
Outgoing Frame Settings 181, 184, 188
Outgoing Frame Settings dialog 142
Outgoing Open Error 141, 146
output trigger 114

P

Pack Repeated Primitives 299
Packet Drop 328
Packet View 41, 205
packing list 18
Partial Memory 103
Paths settings 296
pattern
definition 100
Pattern command 63
pattern definition
in sequential trigger mode 100
Pattern field 113
Pattern Generation file 152, 156
Pattern Generator 150
pattern generator 150, 156
file creation 150
Pattern triggers 78
Payload Data drop-down combo box 134
Payload Size 200
Pending ATA IO 242
Pending SCSI IO 242
performance analysis 37, 167
analyzer only 167
defining 167
Performance Report 231
performance report 230
Periodic Error 177
Phy
reset sequence and initiation 133
PHY Identifier field 465
PHY Setting & Change Speed command 128, 129
PHY/Link layer settings 198
PIO Setup (FIS) 77
PM Performance Report 233
PM Statistic Report 233
pop-up menu
Script Editor 405
pop-up menus
Recording Rules 447
port
renaming 280
status 284
port alias 292
Port Configuration 329, 330, 388
Port Configuration button 106
port ID 280
Port Speed 106
Port Status 44
Post-Trigger Capture tab 65
power management
device initiated 203
host initiated 203
Power Management Setting tab 161
pre-trigger 101
data 102
Pre-Trigger Capture tab 65
Primitive 190
Primitive and Frame Definitions 401
Primitive dialog 67
Primitive Manipulation 328
primitive report 223
primitive response timeout 104
Primitive Type dialog 143, 148, 150, 178
Primitives Decl.inc 402
Print Preview button 235
program lines 120
Program Manager Window 35
project
examples 61
file type definition 60
notes 110
settings 101, 119

project note 110
Project Settings tab 161
Project Tree 49
projects 60
Properties
  option 452
Properties options
  events 452
protocol
  error mask 105
Protocol Analyzer 35
Protocol Analyzer Initiator Emulator 36
Protocol Analyzer setting 296
Protocol Error and Command Settings dialog 139
protocol error report 226
protocol errors 68
Protocol Errors dialog 68, 90

Q

Queue Command Report 232
Queue Settings dialog 152, 157
Quick View 206, 298

R

random data pattern 165
Random Error Injection 140, 145
rate matching 140, 145
Read/Write Command Report 234
read/write command report 230
Rec Analyzer command 330
record and play 136
Refresh (append to) the list of found devices 297
Refresh Device List 29
register device to host (FIS) 74
relative time display 52
Remove Device 28
Remove Frame from sequence 142, 148, 185, 188
Rename Title of Port dialog 280
renaming port 280
Repeat decoded command in frame column 302
Reset (clear) the list of found devices 297
Reset All button 466
resetting
  Toolbar 466
Response frame 281
Restore Factory Presets button 459
Restore Factory Presets option 459
Resume Generation 389
Resume Generation button 392
Retain Error Injection Counters after Link Reset 179
Retry 145
Retry text box 140
Reverse Link Data 299
rules
  validity 447
Run All Tests Sequentially 314
Run Batch button 379
Run Batch Script command 330
run hardware 51
Run Pattern Generator button 150
Run Scenario button 377
Run scripts button 255
Run statement 382
Run Verification Scripts dialog 252
running disparity 279
Running verification scripts button 252
Rx/Tx Settings dialog 295

S

Sample View link 237
Sample View Settings 298
Sampling memory usage optimization 298
Sampling Memory Usage Optimization option 303
SAS Address 391
SAS Address Alias 293
SAS Address field 465
SAS address report 229
SAS Commands icon 182
SAS data pattern 347
SAS Parameters window 80
SAS Protocol Suite 35
SAS Verification 248
SATA cable 22
SATA data pattern 347
SATA Parameters window 81
SATA Protocol Suite 36
SATA Signature 190
SATA Signature dialog 190
SATA Signature Error Setting dialog 191
SATA Signature Errors 191
save
  Display Options 464
  partial trace capture 55, 56, 57, 58, 59
  trace capture 54
Save As Display Formats 56
Save as Text button 235
Save As Text dialog 215, 216
Save button 392
Save Filtered Sample 55
Save Output button 253
scenario 336
  action 348
  creation 353
  downloading 376
  event 344

overview 336
properties 341
running 377
Scenario Batch file 377
Scenario Properties dialog 342
scramble/unscramble payload data 277
scrambling
disable 104
Script Assignment dialog 406
Script Editor 402
buttons 392, 404
pop-up menu 405
toolbar 403
Script Workspace 377
SCSI Command 122
SCSI Command Pattern dialog 95
SCSI Command report 228
SCSI commands
address display 52
SCSI spec assignment 297
SDRAM or Exerciser RAM memory check 314
search 271
by tag 275
complex 455
Direction 457
direction 390, 458
domain 273
Exclusion 457
for data pattern 272, 273
Intersection 457
logic 273
Origin 457
SAS address 274
save setup 272
status 287
STP port 274
sub items 274
Union 457
Search Direction 390
search direction 272
search from 272
search items 273
Search Menu 390
select
item for capture 66
Select Device 25
Select Port Configuration dialog 107
selecting components for installation 20
self test 312
Self Test dialog 312
Send BIST frame 204
Send FIS 179
Send stand-alone primitive 178
Sending Identify Frame 180
separate systems 21
sequence 339
examples 364
Sequential Trigger mode 99
sequential triggering 99
Serial ATA (SATA) data transfers 17
Serial Attached SCSI (SAS) data transfers 17
session 349
Set Alias Name 27
Set As Reference Data Payload 246
Set as Second Data Payload 246
set device bits (FIS) 75
Set Port Configuration dialog 106
Set Speed Negotiating error 196, 197
Set the Anchor row as sync. point 302
Set Time Stamp Origin 261
Set Timers dialog 115
Set Value of Field 189
Setting button 236
Setting dialog 236
settings
advanced mode 119
Settings button 142
Settings command 254
Settings dialog 254
Settings tab 101, 119, 193
Settings.inc File 398
Setup command 20
Setup Display Options button 392
Setup Generation Options button 392
Setup Menu 388
show
all data in data field 283
Show Description window 256
Show Device Library button 376
Show Device Library command 329
Show Grid 256
Show Library command 329
Show Line Numbers command 404
Show Output 256
Show Output command 329
Show Sector Count instead of Xfer Length 302
Show Trainer Frame button 387
Show Warning in Search Primitive In Column View 303
Show XXXX value 105
Show/Hide CMD packet
in results display 276
Show/Hide Command queue
in results display 277
Show/Hide Compare 2 Data Payloads button 246
Show/Hide DLLP packet
in results display 277
Show/Hide Field 280
Show/Hide Link Packet button 276
Show/Hide Physical Packet
in results display 276

Show/Hide TLP packet
in results display 277
Show/Hide Transport Packet button 276
Sierra M6-2 Protocol Analyzer 17
Sierra Trainer menus 387
Sierra Trainer toolbar 392
Simulation Mode 35
Sleep statement 385
smart features 204
SMP Command 125
SMP Command report 228
SMP frame 71
SMP Frame Pattern dialog 71, 93
SMP Initiator field 465
SMP Target field 465
SMP Transport report 227
SMPFrames.inc 402
Snapshot mode 79
SOAF, EOAF and CRC 180
SOF, EOF & CRC Errors 178
SOF, EOF and CRC Errors 191
SOF, EOF and CRC errors 143, 148, 150, 189
SOF, EOF, and CRC errors 185
Soft Reset dialog 98
Software default 297
software installation 20
software overview 35
sorting column content 239
Spec View 217, 278
Specify Action option 452
Specify when to send Signature 190
Speed Negotiation Setting button 151
Speed Negotiation tab 155, 196, 197
Spread Sheet Color Setting 302
Spread Spectrum Clocking 204
Spreadsheet View 41
spreadsheet view 214
SSP Frame 72
SSP Frame Pattern dialog 72
SSP Frame Type dialog 94
SSP Initiator field 465
SSP Target field 465
SSP Transport Report 226
SSPFrames.inc 402
Start Analyzer button 392
Start Generation 389
Start Generation button 392
State 338
statements 380
statistical report
column setting 236
content (SATA) 222
options 223
save as text 235
Statistical Report toolbar 234
Statistical Report View 237
statistical reports 41
Statistics button 244
Status bar 287
Status Bar command 391
Stop Analyzer button 392
Stop Batch Script 330
Stop Generation 389
Stop Generation button 392
Stop Hardware button 79
Stop Initiator Exerciser instruction 132
Stop statement 383
Store Payload in Buffer 146
Store Payload in Buffer check box 140
STP Initiator field 465
STP Target field 465
STP Transport report 227
STPFrames.inc 402
subnet 35
support 471
Switch to CATC Navigation 299
Symbol dialog 84
Synchronize with Trace View 243

T

tabs
file 405
Target
define 193
Target Emulation 393
target emulation 172
Target Emulator 36
target emulator
media settings 193, 200
port selection 194, 200
settings 193
Target Emulator Settings dialog 193
target OOB signal setting 200
target power management 202
Target SAS Address block 134
target speed negotiation 202
Task Attribute 147
task attribute 142
Task Command 124
task command report 228
Technical Support 471
telephone number 471
Template Files 296
Terminate receiving frame 190

Termination
receiving frame 144
Test Result 313
Text View 41
text view 216
Tile Views 257
time
relative display 52
Time Stamp Origin 261
Timeout Pattern dialog 82
Timeouts tab 155, 195, 201
timer
setup advanced mode 115
Timer dialog 82, 99
timers 362
timing
cursors 218
measurement 219
tool bar 286
Toolbar
command 466
Recording Rules 447
resetting 465
tab 466
Toolbar command 286
Toolbars 391
Tools Menu 391
Tools menu (InFusion) 330
tooltips 405
Trace Capture 54
Trace Memory Status section 102
Traffic Generation 44, 387
Traffic Generation (*.ssg) Files 393, 396, 397
Traffic Generation window 387
Traffic Monitoring 328
Trainer toolbar 392
tree 404
trigger
condition 113
external 83
manually 79
multi link 115
on address frame 92
on ATA command 87
on ATA command pattern 98
on ATAPI 88
on bus condition 84
on data pattern 89
on FIS 96
on FIS pattern 97
on pattern 79
on primitive 85
on protocol errors 90
on SCSI Command 95
on SMP Frame 93
on soft reset 98
on SSP Frame 94
on STP frame 91
on symbol 84
on timer 82
position in memory 102
setting advanced 113
setup 78
snapshot 79
trigger on
any ATA command 87
Trigger Source 145
Trigger Source combo box 140
Trigger tab 78
triggering
on timer sequential 99
order 100
triggers
setting 447
Tx Vout 294
Tx Vout & Preemphasis command 295
Type combo box 143

U

Union search 457
unpacking 19
Update License 310
Update Sierra Device 330, 388
Update Sierra Device command 307
Upload Manager dialog 103
USB port 19
User Defined Commands tab 192
user defined decoding 309
User Defined Decoding dialog 309
User Path 296
User-Defined Find Events screen 456
using the cursors 287

V

Value of Reserved Fields 178
Value Replacement 328
VENDOR (FIS) 78
Verification script command 252
Verification Script Engine Reference Manual 252
View Field option 278
View Menu 390
View menu (InFusion) 330
View Options
button 404
menu 404
View Type toolbar 216
Viewer 205
Viewer Setting toolbar 276
Viewer Settings 291
views 41
Visible box 290

W

Wait for Any Frame 132
Wait for Power Management 132
Wait for PS 132
WaitForStop statement 384
walking bit pattern 165
Waveform Display 41
waveform display 218
web site 471
Website, CATC 471
Window Menu 391
Windows default 297
Wrap 391
Wrap button 392
Wrap Packet box 291
wrap packets
in results display 276

Z

Zone Broadcast Method field 465
Zone Device field 465
Zoom In 390
results display 247, 257
Zoom In button 392
Zoom Out 390
results display 247, 248, 257
Zoom Out button 392